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CONTENTS

3743 THE SVS NUMBERING SERIES DISCONTINUED
E.V. Kazarovets, N.N. Samus
7 July 1992

3744 FY PERSEI IS A SHORT PERIOD CATACLYSMIC VARIABLE
A.V. Sazonov, S.Yu. Shugarov
7 July 1992

3745 UBV OBSERVATIONS OF THE RECENT OUTBURST OF THREE CATACLYSMIC VARIABLES
A. Bruch
7 July 1992

3746 THE POSSIBLE ECLIPSES IN THE T TAURI SPECTROSCOPIC BINARY SYSTEM GW ORIONIS
V.S. Shevchenko, K.N. Grankin, M.A. Ibragimov, S.Yu. Melnikov
9 July 1992

3747 THE EXTREMELY YOUNG CLOSE BINARY SYSTEM HERBIG Be STAR V628 Cas = MWC 1080
K.N. Grankin, V.S. Shevchenko, A.V. Chernyshev, M.A. Ibragimov, W.B. Kondratiev, S.Yu. Melnikov, S.D. Yakubov, N.D. Melikian, G.V. Abramian
9 July 1992

3748 LIGHT CURVES OF UY Cam
P. Broglia, P. Conconi
9 July 1992

3749 V2101 Oph IS NOT A CATACLYSMIC VARIABLE
R.A. Dupke
10 July 1992

3750 DISCOVERY OF RAPID OSCILLATIONS IN THE Ap STAR HD 150562
P. Martinez, D.W. Kurtz
21 July 1992

3751 HIGH-SPEED IR PHOTOMETRY OF THE roAp STAR HD 134214
J.A. Belmonte, C. Martinez Roger, I. Vidal
21 July 1992

3752 10 AQUILAE REVISITED: RAPID PHOTOMETRY IN THE IR AND VISIBLE BANDS
J.A. Belmonte, T.J. Kreidl, C. Martinez Roger
21 July 1992

3753 A NEW W UMa TYPE VARIABLE IN CAMELOPARDALIS
P. Broglia, P. Conconi
22 July 1992

3754 UBVR PHOTOMETRY OF THE FAINT ECLIPSING BINARY HS PERSEI
M.M. Zakirov, A.A. Azimov
22 July 1992

3755 THE PHOTOMETRIC RANGE OF EX LUPI
G.H. Herbig, N. Suntzeff, B. Blanco
30 July 1992

3756 ON SEVERAL VARIABLE STARS IN THE FIELD OF M33
A.S. Sharov, V.P. Goranskij, N.N. Samus
10 August 1992

3785 GSC 5198.00659, THE NEW VARIABLE IN AQUARIUS IS A W UMa SYSTEM
J. Schirmer, E.H. Geyer
5 October 1992

3786 Halpha PROFILE VARIATIONS IN THE Be/SHELL STAR Zeta Tau DURING 1990-1992
Guo Yulion, Guo Xiaozhen
8 October 1992

3787 ON THE GENUINE V2045 OPHIUCHI
W. Wenzel, E. Rudolph
8 October 1992

3788 PHOTOELECTRIC LIGHT CURVES OF TY PUPPIS
Gu Shenghong, Liu Quingyao
14 October 1992

3789 DO ALL THREE VARY: Omicron UMa, 23 UMa AND HR 3245
D. Hoffleit
15 October 1992

3790 COMPLETE CCD V, R, I LIGHT CURVES OF BM URSAE MAJORIS
R.G. Samec, T.J. Kreidl
15 October 1992

3791 NEW RESULTS ON THE HIGH AMPLITUDE DELTA SCUTI STAR BE Lyn
E. Wunder, M. Wieck, M. Garzarolli
19 October 1992

3792 A PHOTOMETRIC SURVEY OF SMALL-AMPLITUDE RED VARIABLES
J.R. Percy, C.W. Shepherd
22 October 1992

3793 OW Gem: THE 1991 PRIMARY MINIMUM
P. Pravec
26 October 1992

3794 FLARE STARS IN THE PRAESEPE CLUSTER REGION
G. Gonzalez, C. Escamilla, E. Parsamian
26 October 1992

3795 A PROBABLE RV TAURI STAR NEAR HR Del
R.K. Honeycutt, J.W. Robertson, D.N. Vesper, B.D. Kern, G.W. Turner, J.R. Pier
27 October 1992

3796 1990 AND 1991 PHOTOMETRY OF UZ LIBRAE
P.A. Heckert
28 October 1992

3797 FIRST PHOTOELECTRIC BV LIGHT CURVES, IMPROVED POSITION AND EPHEMERIS FOR THE TOTALLY ECLIPSING EW TYPE SYSTEM V432 Per
F. Agerer
28 October 1992

3798 ON THE VARIABILITY OF BD -3d5183
R.M. Robb
29 October 1992

3799 ON THE PERIOD OF 44i BOOTIS
R.A. Jones
29 October 1992

3800 SPECTRAL TYPES FOR VARIABLE STARS LACKING QUOTED SPECTRAL TYPES IN THE 4th ed. OF THE GCVS
C.B. Stephenson
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NOTES ON THE IDENTIFICATION OF NINE VARIABLE STARS

In the course of preparing finder charts for the Variable Star Section of the Royal Astronomical Society of New Zealand I have noted a number of variables whose data, as given in the New Catalogue of Suspected Variable Stars (Kholopov et al., 1982), and the General Catalogue of Variable Stars (Kholopov et al., 1985), appears to be in error. Generally speaking, coordinates are most frequently at fault. A very useful source of reliable coordinates for faint stars over the whole celestial sphere is the Guide Star Catalogue (GSC) created for the Hubble Space Telescope. The GSC reaches fifteenth magnitude stars in many sky regions, and therefore includes many variables which are too faint to be listed in other general star catalogues.

All of the variables discussed in this paper (with the exception of V449 Lyr) have been identified in the GSC. The bright variables QV Pup, GS Vel, NSV 2954 and NSV 5444 were easily found by inspecting a computer print-out of a small sky window centred on the variable: the faint stars AE Pup, AF Pup, AK Vel and AM Vel lie in rich Milky Way fields and their identities have been confirmed beyond doubt by plotting small charts from the GSC and matching them with the original published finder charts. Table 1 lists the main data extracted from the GSC. Additional notes for most of the variables are given below.

AE Pup, AF Pup, AK Vel, AM Vel. These four stars were first studied by Zagar (1935) who also published finder charts. The published coordinates for all of these stars are in error, the declinations being out by several minutes of arc.

AE Pup :

The GSC lists three close companions. They are

	mag	R.A. (J2000)	Dec. (J2000)
GSC 7667-3073	14.01	$8^h\ 05^m\ 50.03^s$	$-42^\circ\ 30'\ 08.5''$
GSC 7667-3659	14.66	8 05 49.48	-42 30 09.6
GSC 7667-3979	15.01	8 05 50.43	-42 30 35.7

All of these values are means of three plate measurements.

AK Vel :

The error in the position was noted on the VSS, RASNZ chart for BL Vel (chart 828, Bateson and Morel, 1985). The corrected position has not yet appeared in the 4th edition of the GCVS.

AM Vel :

A somewhat brighter star (GSC 8154-445, mag. 12.1) lies 22" of arc to the SW. The error in the position of AM Vel was noted on the VSS, RASNZ chart for BB Vel (chart 367, Bateson et al., 1976), and the corrected position now appears in the 4th edition of the GCVS.

QV Pup :

This variable carbon star has been identified variously as CoD-29°5141 (GCVS, 4th ed.) and CoD-29°5142 (Stephenson, 1973). These two CoD stars lie only 1.5' apart on a line which is nearly North-South. Errors in the declinations of both CoD stars are responsible for the ambiguous identification. Comparison of blue and yellow light plates show the southern star, CoD-29°5142, to be red, and the correct identification. Coordinates (1950): $7^h\ 53^m\ 13.0^s\ \ -29^\circ\ 31.2'$.

GS Vel :

The photometric variability of this star was first noted by Humphries et al. (1972), where their UBV measurements varied from 9.21 to 9.45 in V. They identified this M2 Ib supergiant by a CoD number, CD-55°3622. This DM number corresponds, however, to HDE 301021, of spectral type F8, and hence appears to be incorrect. The correct identification appears to be a nearby star HDE 301022 (MO) = CPD-55°3815. This star is not in the CoD.

Correct coordinates for GS Vel = CPD-55°3815 are

(1875)	10^h	40^m	29.5^s	-55°	$57.4'$	(CPD)
(1950)	10	43	30	-56	21.0	.

Finder charts. GS Vel is plotted incorrectly on VSS, RASNZ chart 554 (Bateson et al., 1981), but the correct identification is made on chart 869 (Bateson and Morel, 1986).

NSV 2954 :

There is a misprint in the paper by Hawarden (1975) where the star's variability was first suggested. The star is stated to be in the vicinity of the cluster NGC 2243 (R.A.=$6^h\ 28.7^m$ Dec.=$-31^\circ\ 16'$). The star number cited is HD 45095, but this star is far from the cluster and its spectral type (G2 V) does not match the colours published by Hawarden. The cor-

Table 1:
IDENTIFICATIONS AND COORDINATES FOR NINE VARIABLE STARS.

STAR	GSC No.	GSC Mag(J)	Mean Position (J2000) h	m	s	°	'	''	N
AE Pup	7667-3465	13.64	8	5	51.25	-42	30	38.3	3
AF Pup	7672-129	14.13	8	13	38.75	-43	7	46.4	3
AK Vel	8136-2430	12.99	8	5	53.88	-46	36	58.1	1
AM Vel	8154-114	13.96	8	35	37.03	-47	45	33.9	3
QV Pup	6565-1227* 6565-3198*	13.33 9.55	7	55	13.30	-29	39	7.2	2
GS Vel	8622-2228	8.96	10	45	30.86	-56	36	42.5	2
NSV 2954	7074-1253	7.53	6	30	0.64	-31	10	26.3	1
NSV 5444	8229-2057	9.40	12	4	5.31	-45	56	14.4	1
V449 Lyr	----------	----	19	7	37	+44	0.2		---

N = number of GSC plate measurements.

Note:

* For QV Pup, two GSC stars with nearly identical coordinates, differing only 0.03s in R.A. and 0.6" in declination. Assumed to be one and the same object.

rect identification is probably HD 46095 = SAO 196879 which lies only 8' from NGC 2243 and has suitable spectral type (A0 V) and magnitudes (7.4v, 7.4p) to match the known colours.
Coordinates (1950): $6^h\ 28^m\ 7.0^s$ -31° 08' 21" (SAO).

NSV 5444 :

Is star 35 in standard region E5. This star is HD 104806 = CoD-45°7506 = CPD-45°5761. Declination in NSV is in error, and should be -45°39.5'. NSV position apparently refers to CPD-45°5762, a faint non-HD star 1'54" due S of the HD star.

V449 Lyr :

Announced by Romano (1972). Range 12.5 - 16.0p. Lies quite close to MV Lyr, for which a finder chart appeared in AAVSO Circular 47 (1974). V449 Lyr is situated slightly south-west of star '121', but is not plotted on the chart, which appears to reach thirteenth magnitude, at least. V449

Lyr is not listed in the GSC, whose limiting magnitude is about 14.4V in this region.

Possibly the published maximum magnitude is too bright, by as much as two magnitudes. The published position needs revision. An improved, but still approximate position is given in Table 1.

The identifications and coordinates found for these variables in the GSC are summarized in Table 1. The meanings of most column headings are self-evident. Column 3 gives mean values of GSC magnitudes. All of the southern GSC magnitudes are derived from plates of the UK SERC J Survey (blue-green sensitive). Column 5 gives the number of plate measurements, N.

I thank Mr Albert F. Jones of Stoke, Nelson, New Zealand for kindly furnishing an early number of IBVS.

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IDENTIFICATIONS AND COORDINATES FOR NINETEEN NSV STARS

The New Catalogue of Suspected Variable Stars (Kholopov et al. 1982) contains a number of neglected stars which have been known for many decades. It is clear that for some NSV stars further study is hampered by the scanty nature of the published data, i.e. coordinates of low accuracy; magnitude ranges which may refer to an obsolete magnitude scale; finder charts which are non-existent.

An example of a set of variables which illustrates the above difficulties is the set of twenty six new variables announced by Voûte (1927). Five of these have received official names (MW Cen, TV Hya, RZ Nor, TU Nor, and probably LQ Nor reported in this present work). Two other stars, NSV 5596 and NSV 7789, were known at discovery to be CPD stars. We are left with nineteen variables whose identities are still somewhat obscure - the published coordinates are only approximate, no finder charts exist, and no magnitudes are available at all for many of them.

The purpose of this paper is to establish secure identifications for the nineteen poorly known variables. The remainder of Voute's stars, mentioned above, are better known and will not be discussed further. I have used Voûte's original discovery paper to determine the position of each variable with greater accuracy. He gave brief descriptive notes for each star, regarding its apparent behaviour and position relative to nearby CPD stars. These offset positions usually (but not always) enabled me to pin down the location of each variable with higher degree of confidence. Small finder charts were plotted for each object using stars extracted from the Guide Star Catalogue (GSC). The limiting magnitude of the GSC charts is generally around 13.5(J) which is very similar to the limit of the original plates used to discover the variables (Voûte 1927). An inspection of each GSC chart generally revealed a suitable candidate. For a few of Voûte's stars no obvious candidate could be found in the GSC, so Robert H. McNaught (Siding Spring Observatory) kindly agreed to search UK Schmidt plates for possible candidates. The results of the research are summarized in Table 1. Additional notes appear below for a small number of stars difficult to identify.

NSV 4897: Has two fainter companions. The first one, of about magnitude 13.0, lies 6s preceding, 17" N. The other is of magnitude 13.5 and lies 54" N; it is known as GSC 8609-1976.

NSV 5060: The probable candidate is an anonymous star of about magnitude 14, located 1.0′ N of the position given by Voûte. No star seen at his position on UK Schmidt plate J2237, 1976 April 22. No variable or coloured star in vicinity, according to McNaught (1991).

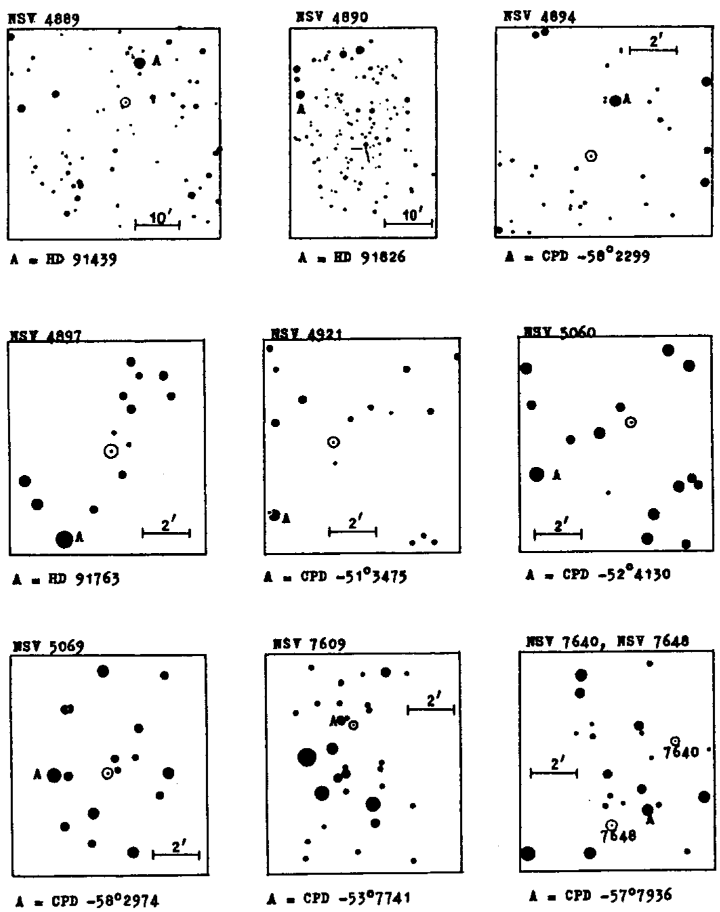

Fig. 1. Finder charts for the NSV stars. North is up, and East is left for each chart. Scale bar in each chart gives the scale in arc minutes.

NSV 7679: Identity a little unclear. UK Schmidt plates show an anonymous red star very close to the position stated by Voûte, but it is rather faint and probably too faint for his plates. No variability found by McNaught (1991). Voûte suggested that his variable is of Algol type, of period 11 days or a submultiple of it, and amplitude 0.6 mag. The nearby star GSC 8320-2049 is the more likely candidate, as it is not particularly coloured (by comparing UK Schmidt J and I plates) and is within the limit of the discovery plates.

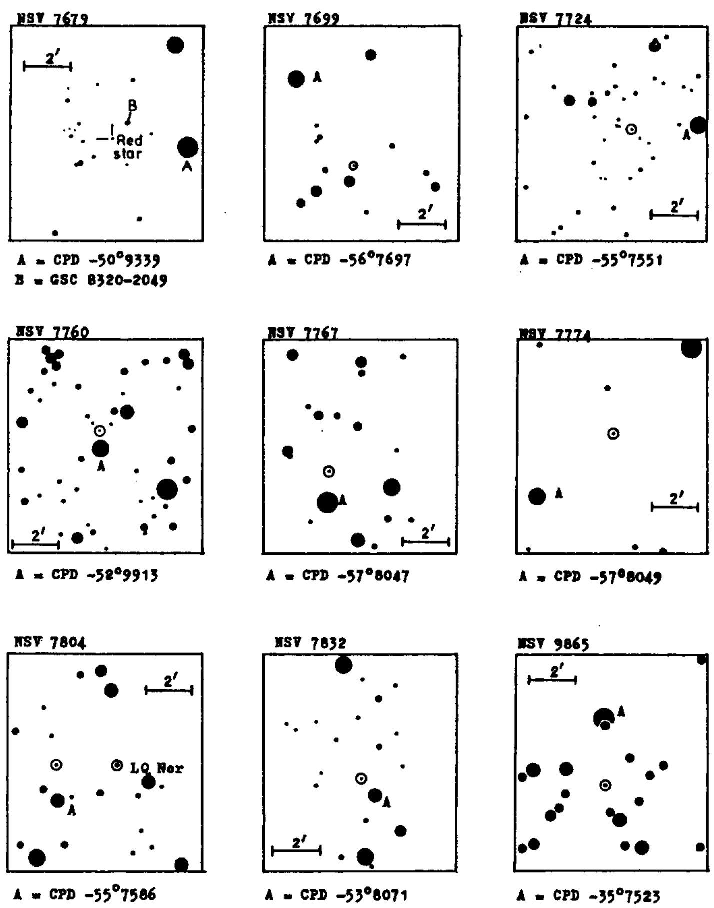

Fig. 1 (contd.). Finder charts for the NSV stars. North is up, and East is left for each chart. Scale bar in each chart gives the scale in arc minutes.

NSV 7724: Identity a little unclear. Candidate listed in Table 1 is the brightest star in the immediate vicinity of Voûte's coordinates. Other, fainter stars lie closer to his position. No variable or coloured star in vicinity, according to McNaught (1991).

Table 1:
IDENTIFICATIONS AND COORDINATES FOR NINETEEN NSV STARS.

NSV No.	GSC No.	GSC Mag(J)	R.A. (2000)	DEC.	Voûte Id. (1875 position)	Remarks
			h m s	° ′ ″		
4889	8209-266	12.52	10 32 43.9	-50 46 52	10 27.6 -50 8	
4890	8956-2001	11.55	10 32 49.8	-60 27 52	10 28.2 -59 50	
4894	8613-2569	12.99	10 33 45.5	-59 37 33	10 29.1 -58 59	
4897	8609-2859	12.04	10 34 14.9	-56 45 59	10 29.3 -56 7	Two companions.
4921	8209-1199	12.62	10 38 51.5	-52 04 13	10 33.7 -51 25	
5060	————	(14)	11 01 30.0	-53 34 45	10 56.1 -52 56	Best candidate.
5069	8627-898	11.99	11 02 42.5	-59 36 36	10 57.5 -58 56	
7609	8711-3885	12.62	16 19 43.2	-53 44 38	16 10.0 -53 28	
7640	8719-1115	10.99	16 22 12.3	-57 40 23	16 11.9 -57 22	
7648	8719-1381	11.26	16 22 32.5	-57 43 56	16 12.2 -57 26	Misprinted as 16 22.2.
7679	————	<14	16 24 22.1	-50 26 17		Doubtful. Red.
7679	8320-2049	12.60	16 24 18.3	-50 25 33	16 14.9 -50 9	Good candidate. White.
7699	8719-818	13.48	16 26 32.9	-57 01 47	16 16.2 -56 44	
7724	————	(13.5V)	16 28 08.0	-55 38 16	16 18.1 -55 20	Best candidate.
7760	8712-348	11.88	16 30 58.0	-52 49 49	16 21.2 -52 33	
7767	8720-116	12.72	16 31 39.7	-57 40 55	16 21.2 -57 24	
7774	8720-1256	13.37	16 31 59.8	-58 07 17	16 21.6 -57 52	
LQ Nor	8716-295	12.25	16 33 39.4	-56 12 29	16 23.6 -55 56	Same 1875 coords.
7804	8716-317	12.71	16 33 57.8	-56 12 31	16 23.6 -55 56	given by Voûte.
7832	8712-2444	11.98	16 35 55.5	-53 16 27	16 26.1 -53 0	
9865	7386-1741	11.56	17 56 46.3	-35 14 52	17 48.4 -35 13	=CoD-35 12083 =CPD-35 7524

Table 1: The data found for each NSV star is given here. The columns are as follows :
Column 1 : Star number in the NSV Catalogue.
" 2 : Star number in Guide Star Catalogue (GSC).
" 3 : Magnitude from GSC (from UK Schmidt J plates).
" 4 : Coordinates (J2000) from GSC.
" 5 : The identifier used by Voûte (1927). He did not assign temporary designations, but instead referred to each star by its approximate 1875 coordinates.
" 6 : Remarks.

Charts: Fig. 1 gives finder charts for all variables. The scale of each chart is indicated, together with the CPD star used for offsetting by Voute.

I wish to thank Mr Albert F. Jones of Stoke, Nelson, New Zealand, and Mr Robert H. McNaught of Siding Spring Observatory, NSW, for providing material and observations used in the preparation of this paper.

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ON MAGNETIC FIELD OF Be STARS EM Cep AND LQ And

Some Be stars have a low-amplitude (not larger than $0^m_.1$) photometric variability with periods within an interval of $0^d_.5$-2^d and a characteristic brightness curve which has two minima and maxima. EM Cep (BI IVe, P = $0^d_.806187$ (Breinhorst and Karimie, 1980)) and LQ And (B3-4, IV-Ve, P = $0^d_.061904$ (Harmanec et al., 1991)) are the most typical representatives of this group of objects.

Harmanec (1984) has suggested that these stars have the same nature of variability as σ Ori E, a known Be star with a magnetic field (Landstreet and Borra, 1978), whose variability coincides with the photometric period $1^d_.19080$. In May 1990 we obtained some estimates for the magnetic field of these stars in order to check this hypothesis.

Observations of EM Cep and LQ And were carried out at the primary focus of the 6-m telescope with a hydrogen magnetometer (Shtol' 1991). The measurements were made simultaneously in the wings of hydrogen lines H_γ and H_β with a mask width of 10 A (5 A from the line core). The hydrogen line profiles of these stars were investigated in a preliminary way from the high-dispersion spectrograms obtained on the same telescope. This allowed to select the width and location of the mask so that to exclude the contribution from the envelope component to the measurement of circular polarization as much as possible. So, in the case of EM Cep there is no envelope contribution and it is not significant in the region of H_β line in the case of LQ And. Altogether we obtained 5 polarization estimates for EM Cep and 1 estimate for LQ And during 3 nights.

The results are presented in Table below:

JD	Δt(day)	Be(Gs)	$\pm\,\sigma$
2440000.+			
			EM Cep
8026.4800	0.0779	-429	297
8027.4376	0.0577	+ 96	342
8027.4944	0.0536	-122	352
8028.3995	0.0655	-435	354
8028.4493	0.0309	+261	501
			LQ And
8026.4991	0.0576	+491	266

These results show that EM Cep probably has neither a magnetic field exceeding the observation error nor a variability with the photometric period of $0^{d}.806187$.

The only estimate of the magnetic field of LQ And does not allow to draw any conclusion on the presence of a magnetic field. A comparison of our data with the magnetic field strength for this star obtained earlier by Harmanec et al. (1991) points that it is either absent or small.

Thus, our observations of EM Cep and LQ And cast doubt on similar nature of variability of these stars and the magnetic Be star σ Ori E.

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A MAJOR PERIOD CHANGE OF VW CEPHEI

VW Cep is one of the most extensively observed W UMa type binaries. The light curve shows two almost equal eclipses of about $0\overset{m}{.}4$ in V but the minima are sometimes asymmetric and the shape of the light curve is slightly different at different epochs. Yamasaki (1982) and Linnell (1980) have attempted to explain the variations in terms of starspots, not unlike the RS CVn variables, and Van't Veer (1991) has continued with this theme by exploring the role of magnetic effects on period changes. The changes in the light curve have also been attributed to mass transfer (Karimie 1983). The spectroscopic and photometric evidence suggests that the components of the binary are in marginal contact, with the secondary being slightly hotter than the primary (Hill, 1989). VW Cep is typical of the W-type W UMa systems (Hilditch *et al.* 1988). According to the models (*cf.* Robertson & Eggleton 1977, Lucy & Wilson 1979) these systems oscillate between contact and semi-detached states on a thermal timescale ($\sim 10^7 yrs$) spending most of the time as contact systems. During the contact state mass is expected to be transferred from the secondary to the primary and the period, assuming conservative mass exchange, is expected to increase. The period of VW Cep is known to vary but the problem is complicated by a faint third companion which was discovered astrometrically (Hershey 1975). The orbit of VW Cep about the common centre of gravity causes a change in the light travel time from the variable which introduces a distortion into the O-C diagram.

New photoelectric observations of VW Cep have been made during 1991 from Hadlow, Kent and Catsfield, East Sussex in southern England (see Table 1). Observations marked JW were made from Catsfield with a 25-cm Newtonian equipped with a prototype JEAP photon counting photometer using an EMI9924B PMT (Walker 1986, 1991) with computer controlled data acquisition. Integration times were 30 seconds through a 1 arc minute aperture. Observations marked RDP were made from Hadlow with a 40-cm Newtonian equipped with an EMI6526B PMT feeding a J-FET DC amplifier. The signal was passed to a voltage to frequency converter and read off a digital meter. Integration times were 10 seconds through a 2 arc minute aperture. The comparison star used throughout was BD +75° 753

(HD 197750 = BAA VSS Comp B) and the check star was BD +74° 877 (HD 197617 = BAA VSS Comp C). All observations were made through Johnson V filters. The observed times of minimum were determined by fitting low order polynomials to the observations and the errors are estimated to be < 0.005 days.

To construct the O-C diagram the new timings have been combined with other times of minimum taken from the compilation of Karimie (1983), BAA VSS Circulars and from recent IBVS's. Before any investigation of the period change can be made it is necessary to correct the O-C residuals for the light travel time and for this the elements given by Hershey (1975) have been used. The figure shows the light time corrected O-C diagram and the light time correction itself. The O-C diagram is characterised by a general shortening of the period which takes place through a number of discrete period changes. Major changes in period at JD $\sim$ 2431000 (1943) and 2437100 (1960) have been recognised before but a new major change at JD $\sim$ 2444600 (1980) seems to have passed largely unnoticed.

It can be seen that the only significant departures from straight line segments occur near the time when the light time correction is changing most quickly. While this feature has in the past been attributed to small period changes it seems more likely that it is an artifact caused by a small error in the light time correction, which could be removed by a small change to P or ω. If this is the case then the behaviour of VW Cep may be accounted for by three approximately equal discrete reductions in the period at $\sim$ 20 year intervals (see Table 2). Karimie also supports the notion of discrete period changes.

The widely used ephemerides now give gross errors so a new one is necessary. A linear fit to the uncorrected data from 1984 to the present yields a new *observed* ephemeris for primary minimum of:

$$\begin{array}{rcl} JD_{min1} = & 2446822.5233 & + \; 0.2783099 \cdot E \\ & \pm 3 & \pm 1 \end{array}$$

This ephemeris will slowly drift off because it takes no account of the light time correction but if the period remains constant the error could reach at most -0.01 days in five years. On past behaviour the period might be expected to change again around the turn of the century.

VW Cep poses some interesting problems because the general trend of the period change, which is well represented by $\dot{P}/P = -7.4 \times 10^{-7} yr^{-1}$, is similar to the value expected for "broken-contact" W UMa systems (Lucy &

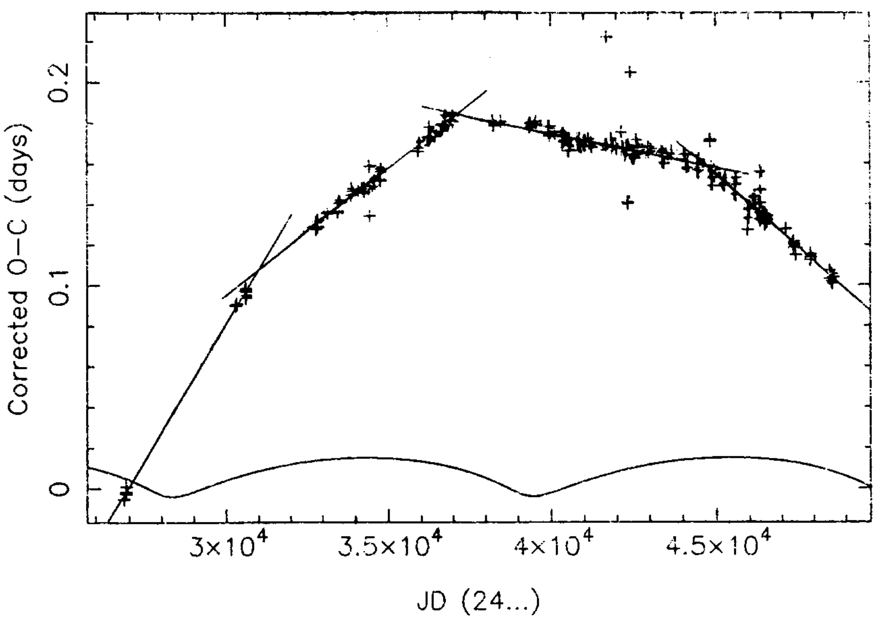

Figure 1: Light-time corrected O-C diagram showing the four constant period sections. The curve shows the light-time correction that was applied.

Table 1: New times of minima

HJD	min	observer
2448506.4398	2	RDP
2448506.5751	1	RDP
2448566.4134	1	JW
2448570.5864	1	JW
2448597.3037	1	JW
2448600.5034	2	RDP
2448604.2601	1	JW
2448619.2883	1	RDP

Table 2: Values of discrete period changes

Year	1943	1960	1980
$\Delta P/P$	-1.4×10^{-5}	-1.6×10^{-5}	-1.1×10^{-5}

Wilson, 1979) and not the W-type like VW Cep. Also, because the period changes are abrupt it suggests that the contact between the two stars is episodic and very brief, which implies a more complex relationship between the components than current theory suggests.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

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UBV OBSERVATIONS OF ZZ CMi

ZZ CMi (BD +09°1633) is a poorly observed star. It is classified in the General Catalogue of Variable Stars as a semi-regular variable with a spectral type of M6I-IIep. On the base of 35 photographic observations covering a period of about 40 years Tshernova (1949) suggested a possible period of about 500^d for the brightness variations. The spectroscopic observations of Sanford (1947) showed absorption features corresponding to a spectral class M6 and low excitation emission lines. Later Iijima (1984) noted the presence of high excitation emission lines of [OIII] and [NeIII]. Bopp (1984) reported Hα variability and infrared photometry. Iijima (1984) and Bopp (1984) interpreted their observations as evidence that ZZ CMi is a symbiotic star.

We observed ZZ CMi photoelectrically during the period January - May 1991 as a part of the study of symbiotic and symbiotic-like stars carried out in the National Astronomical Observatory Rozhen. The observations were obtained with the 0.6m telescope and a single channel photon counting photometer. HD58367 (V=4.996, B-V=1.002, U-B=0.783) was used as the comparison star. The data processing and reduction to the standard UBV system are made with the software of Kirov, Antov and Genkov (1991). The internal accuracy

Table 1

HJD2440000+	V	B-V	U-B
8255.584	9.78	1.64	0.69
8262.353	9.57	1.57	0.88
8274.306	9.70	1.52	0.71
8275.529	9.74	1.54	0.71
8278.530	9.74	1.54	0.63
8291.495	9.94	1.45	0.50
8292.313	9.94	1.47	0.60
8308.356	10.13	1.45	0.43
8321.315	10.08	1.46	0.48
8337.338	9.75	1.49	0.47
8338.283	9.77	1.52	0.61
8339.360	9.76	1.50	0.44
8340.379	9.75	1.53	0.60
8341.284	9.76	1.52	0.51
8383.280	9.78	1.53	0.46

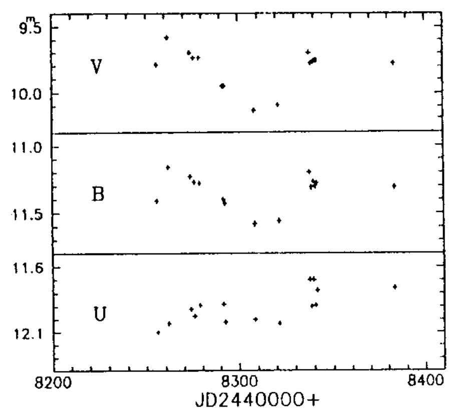

Figure 1

is ± 0.03 in V, ± 0.04 in B-V and ± 0.05 in U-B.

Table 1 summarizes our results. Obviously the colours do not correspond to the normal M6 giants (Allen, 1973). U-B is remarkably bluer and points to the presence of a hot source.

In Figure 1 the U, B and V magnitudes are shown. A minimum in the B and V bands at the end of February 1991 (JD2448310) is visible. The amplitude of the variation in B is smaller by about $0^{m}.1$ than in V. The behaviour in U is different and the changes are not so strong.

Our UBV observations are in agreement with the supposition ZZ CMi to be a symbiotic binary system. The M giant dominates the radiation in B and V and probably semi-regular variability causes the changes in these bands. The brightness in U can be influenced by a less luminous hot companion.

Systematic observations are necessary to reveal the nature of this object.

We are grateful to M. Ivanov for help in the observations. This work was supported by the grant F-35 from the Bulgarian Ministry of Education and Science.

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COMMISSIONS 27 AND 42 OF THE IAU
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Number 3706

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CV IN CORVUS: NO OUTBURSTS ON BAMBERG PLATES

The discovery by C.W. Tombaugh of a cataclysmic variable in Corvus at $\alpha = 12^h17^m49^s$ and $\delta = -18^o10'27''$ (1950.0) was communicated by Levy (1990).The search by Levy through 260 Harvard College Observatory plates revealed 9 another maxima between 1932 and 1988. Another outburst was reported in 1990 (Levy, 1990) increasing the number of known outbursts to 11. The magnitudes of these outbursts were estimated to reach up to 12^m.

The position of the object was investigated on 107 plates taken with 7-25 cm aperture cameras at the Southern Stations of the Bamberg Observatory during years 1964-1967 and 1971-1974. The limiting magnitudes of these plates (13-15 mag.) are too low to enable the studies of the object in quiescence (~ 17-18 mag.) but is enough to record the outbursts of the object as described by Levy (1990).

The investigated Bamberg plates represent nearly 100 h of monitoring time. Assuming the typical dwarf nova behaviour, i.e. the duration of the outbursts > 1 day, one would expect to detect ~ 4 brightenings (taken the 9 outbursts detected on 260 HCO plates into account). Since none was found, we conclude that there probably exists active and inactive long-term periods in which the outbursts occur and/or not occur . Similar behaviour was already observed e.g. in GK Per (Hudec, 1981). With the exception of the 1971 Apr 20 outburst, all other brightenings revealed by Levy (1990) appeared in the time periods 1932-1952 and 1983-1990, while the majority of our data corresponds to time period 1964-1967 with only sparse data for 1971-1974. Thus I conclude that the outbursts were less frequent or even absent in the time period 1964-1967. Another explanation is however also possible, namely that the outbursts are, in fact, fainter than ~ 14^m, i.e. fainter than reported by Levy (1990).

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HU ISSN 0374 - 0676

LIGHT CURVE AND COLOR VARIATIONS OF V2101 Oph IN 1991

During observations of the variable stars IX and KK Oph using the 0.6m Zeiss reflector equipped with a pulse - counting photometer at Mt. Maidanak Expedition on 27 June 1991 we detected a rise in the light of the neighbouring U Gem-type star V2101 Oph (Khruzina and Shugarov, 1991). UBVR-monitoring of this star was continued with the same telescope up to September. The results of the photoelectric photometry are listed in Table I.

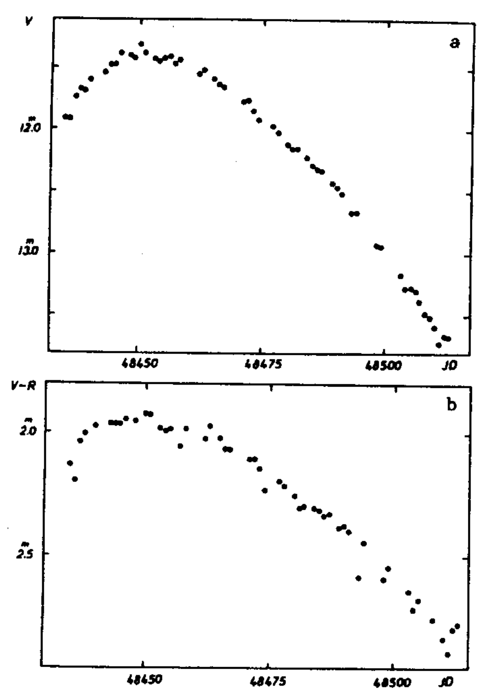

Figure 1

Table 1. UBVR photometry of V2101 Oph in 1991

JD(2448..)	V	U-B	B-V	V-R	JD(2448..)	V	U-B	B-V	V-R
435.340	11.88	1.32	2.16	2.10	473.199	11.85		1.93	2.14
435.397	11.93		2.12	2.17	474.228	11.92		1.86	2.23
435.405	11.93			2.15	477.190	11.97	0.58	2.02	2.19
436.324	11.92			2.19	478.199	12.02	1.49	2.03	2.21
437.336	11.74		1.89	2.03	480.186	12.12		2.07	2.25
438.346	11.67		1.84	2.00	481.220	12.15		2.05	2.30
439.329	11.69		1.84		482.227	12.15		2.02	2.29
440.300	11.60	1.82	1.90	1.97	484.185	12.22		1.95	2.30
443.286	11.54		1.83	1.96	485.169	12.29		1.94	2.31
444.276	11.48	0.97	1.82	1.96	486.159	12.32		1.86	2.33
445.282	11.47		1.81	1.96	487.164	12.33		2.01	2.32
446.276	11.38	0.99	1.83	1.94	489.165	12.43		2.28	2.38
448.269	11.40	0.99	1.91	1.95	490.190	12.46		2.19	2.37
449.339	11.42		1.92		491.191	12.51		2.30	2.39
450.287	11.31		1.84	1.92	493.195	12.67:			2.58
451.253	11.38		1.90	1.92	494.191	12.67		2.36	2.44
453.267	11.43	1.01	1.89	1.98	498.199	12.93		2.14	2.59
454.283	11.45		1.87	1.99	499.157	12.94	0.43	2.08	2.54
455.313	11.42	1.25	1.91	1.98	503.162	13.17		1.95	2.64
456.313	11.41	1.20	1.91		504.159	13.28		1.76	2.71
457.312	11.47		1.93	2.05	505.147	13.27		2.07	2.67
458.269	11.43	0.83	1.77	1.98	506.158	13.30		2.11	
462.263	11.55		1.73	2.02	507.161	13.38		1.92	
463.230	11.51		1.86	1.97	508.160	13.48	0.52	1.89	2.75
465.202	11.59	0.90	1.88	2.02	509.161	13.51		2.01	
466.195	11.63	1.97	2.12	2.06	510.156	13.59		1.93	2.83
467.200	11.65		1.89	2.06	511.140	13.72		1.93	2.89
471.215	11.77		1.94	2.10	512.141	13.66		1.97	2.79
472.225	11.76		1.92	2.10	513.141	13.67		2.11	2.77

CoD-27^{o}10844 was used as the comparison star (V=7.800, U-B=-0.07, B-V=0.415, V-R=0.423). The light curves of the variable in V and in color (V-R) are presented in Figure 1 a, b, V - (V-R) diagram is shown in Figure 2. The light maximum in V band corresponds to JD = 2448451.5.

Our photographic estimates of V2101 Oph for 1985-1988 obtained using the plates exposed on the Zeiss Double Astrograph with the limiting magnitude about 17 pg are collected in Table 2. One of the 8 plates shows the star of 13.8 pg (16 August 1987), but on the other plates the magnitude of the star varies near its minimum.

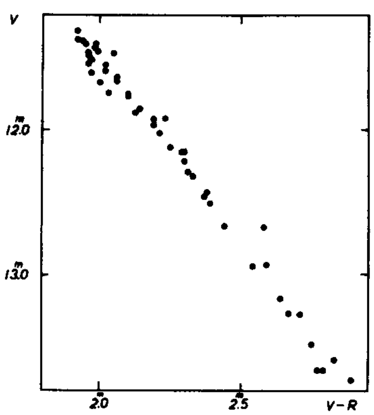

Figure 2

Table 2.

JD(244...)	m(pg)
6295.3	15.4
7024.3	13.8
7323.3	15.9
7327.3	16.0
7330.3	16.0
7331.3	16.1:
7349.3	16.4
7354.3	>16.5

The shape of the light curve during the observational interval, color variations, as well as extremely red color of V2101 Oph are not typical of U Gem-type variables. Moreover, the brightness increase reaches its maximum in B and decreases to R. Therefore we suspect V2101 Oph to be a Mira-type or late type semiregular variable.

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COMMISSIONS 27 AND 42 OF THE IAU
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HU ISSN 0374 - 0676

1991 V-Band Photometry of an Eclipsing Binary: 1E 1919+0427

As part of our long-term observing program of chromospherically-active binary stars, we have observed a photometric light curve of the RS CVn candidate 1E 1919+0427 at V-band. The light curve shows that it is an eclipsing system with evidence of a distortion wave.

1E 1919+0427 was discovered to be an x-ray source in 1986 (Takalo, 1986). Takalo and Nousek (1988) investigated the source spectroscopically. They found that it is a double-lined binary system with observed spectral classes G5 V and K0 III - IV, as are typical for an RS CVn. Based on radial velocity measurements, they arrived at an orbital period of 0.8 days.

We observed 1E 1919+0427 on September 25 and 26 and October 4 and 17 of 1991 with the 61-cm telescope at Capilla Peak Observatory equipped with a Photometrics CCD camera (Laubscher et al., 1988). We used this system as a multichannel photometer to sample sky, variable, and the comparison star simultaneously. Our filter set (Beckert and Newberry, 1989) is matched to Johnson at V. Typical exposures were 40 - 50 seconds at V. We used star "B" in figure 1 as a comparison star. Star "C" was used as a check star.

From our photometry, we were able to get precise times for primary and secondary eclipse. With this information we applied a Lafler-Kinman period search to find the period elements of 1E 1919+0427:

$$JD_{max} = 2448533.71141 + 0.83414E$$

The V light curve is plotted at the 0.83414 day period in figure 2. This figure shows delta magnitudes in the instrumental system. The statistical error in the observations is about 0.01 mag.

We noted that the star's magnitude as it enters primary eclipse is higher than as it comes out of eclipse -- evidence of a dark, spotted region. This region is modeled using an information limit optimization analysis (Budding and Zeilik, 1987). We have taken T_1 = 5780 K, T_2 = 5260 K, and i = 85.29°

FIGURE 1: Finding Chart for 1E1919+0427 with Comparison Stars labeled.

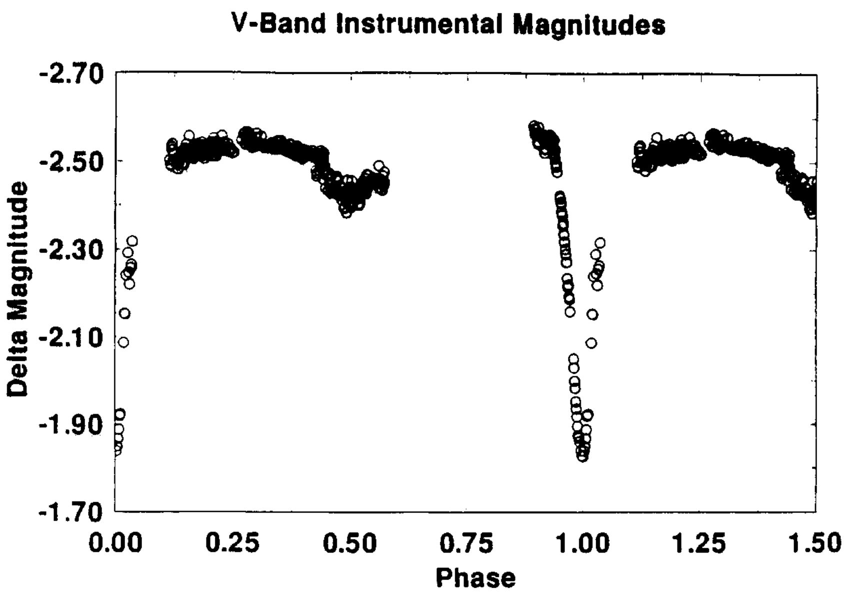

FIGURE 2

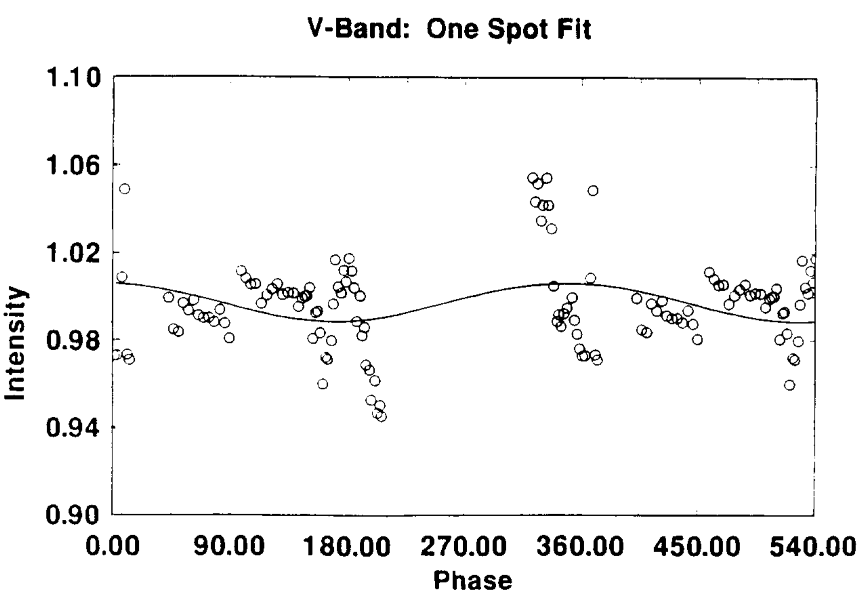

FIGURE 3

to make this fit with a black (T = 0K) spotted region. The derived starspot parameters were: longitude = 168.49°± 14.32, latitude = 87.25°± 0.42 and radius = 38.42°± 0.31. Because we only sample the star in V-band we do not have enough information to find a blackbody spot temperature. Clearly, we need complete light curves at two colors in consecutive observing seasons to track the magnetic activity of this system.

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BINARIES IN THE VICINITY OF THE OPEN CLUSTER IC 4665: II. V 2203 Oph

The investigation of the eclipsing variable V 2203 Oph is a continuation of our programme for studying binaries in the wide vicinity of the open cluster IC 4665 (Kraicheva et al., 1989).

V 2203 Oph was discovered by Zinner (1952). Later Stiegler has found rapid light variations between $10^{m}.9$ and $12^{m}.2$ on the basis of 33 photographic observations. Using 184 plates taken with the 40-cm astrograph of the Crimean Station of Sternberg Institute, Moscow, in time interval JD 2442812 - 44021, Surikov (1982) classified the star as a W UMa variable with a period P = $0^{d}.455001$ and light variations between $11^{m}.56$ and $11^{m}.94$, Min II $11^{m}.80$.

Our observations of V 2203 Oph, total number 239, in time interval JD 2444402 - 7056, were performed at the National Astronomical Observatory "Rozhen". 230 plates were taken on 50/70-cm Schmidt telescope, 9 on 2-m RCC telescope and 7 photoelectric observations with 60-cm telescope were added. Photometric measurements of the plates were carried out with the automatic iris photometer Ascoris (Carl Zeiss, Jena) at the National Observatory "Rozhen". The magnitude evaluations of some plates were made by Nijland - Blazhko method. We used Surikov's comparison stars, but our B magnitudes determined with the iris photometer are systematically smaller. These magnitudes together with the identification chart are shown in Figure 1. The measurements were based on the standard stars in cluster IC 4665 (Kazanasmas et al., 1982). UBV magnitudes of comparison stars a, b and c were measured also photoelectrically. Star No.42 was used as a check star, and No.46 as a standard one. The results are given in Table I.

The results confirm V 2203 Oph as an eclipsing binary of W UMa type. A more precise value of the period of light variations was determined: P = $0^{d}.4550021$. Our observations, together with those of Surikov cover 9326 cycles. The element of light variations

$$\mathrm{Min_{hel}\,I} = \mathrm{JD}\ 2442812.645 + 0^{d}.4550021\mathrm{E}$$

satisfy well all observations between JD 2442812 and JD 2447056. During

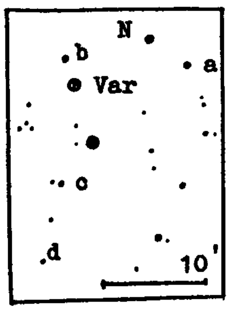

Figure 1

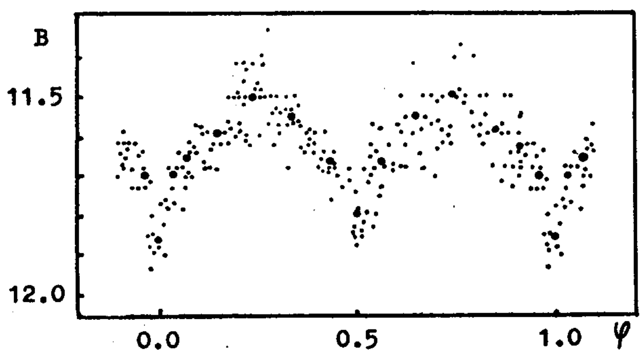

Figure 2

Table 1

	B		V	B–V	U–B
a	11.16	a	10.530	0.634	0.163
b	11.50	b	10.860	0.639	0.111
c	11.85	c	11.411	0.439	0.177
d	12.12				

this interval the period has been unchanged.

The mean light curve of V 2203 Oph from "Rozhen" observations is presented in Figure 2 together with the individual observational data. The amplitude of the light variations was found to be $0\overset{m}{.}36$ ($11\overset{m}{.}50$–$11\overset{m}{.}86$), Min II $11\overset{m}{.}80$.

More observations of V 2203 Oph during a longer time interval are needed for studying possible variability of the period, which is a characteristic feature for W UMa type stars.

Table 2

JD_{hel} 244..	B	JD_{hel} 244..	B	JD_{hel} 244..	B	JD_{hel} 244..	B
4402.459	11.62	4760.529	11.64	5139.471	11.59	5880.416	11.57
.548	11.50	.547	11.64	171.465	11.50	.444	11.64
403.457	11.33	.548	11.64	172.331	11.59	.468	11.64
.549	11.68	.549	11.71	.421	11.59	.508	11.71
427.420	11.73	.550	11.64	173.397	11.64	881.431	11.58
428.446	11.50	.551	11.64	175.488	11.68	906.356	11.53
429.396	11.50:	761.369	11.64	195.361	11.68	.390	11.64
.425	11.52	.409	11.93	.389	11.50	.450	11.57
.455	11.68:	.476	11.63	196.343	11.60	.478	11.50
430.404	11.74	.480	11.59	203.316	11.59	.507	11.50
.440	11.62	762.423	11.50	224.394	11.77:	908.519	11.57
.462	11.55	.467	11.50	226.304	11.50	936.349	11.50
455.373	11.59	779.360	11.76	437.486	11.59	995.252	11.62
.454	11.75	.398	11.85	.513	11.59	6181.546	11.68
456.383	11.68:	780.365	11.42	461.389	11.58	.565	11.42
.424	11.50	.407	11.59	.414	11.68	183.440	11.68
458.376	11.73	781.347	11.57	.437	11.68	.470	11.64
722.452	11.62	783.358	11.48	468.443	11.68	199.409	11.68
.490	11.68	.373	11.59	526.364	11.50	.443	11.90
724.430	11.62:	.408	11.50	554.350	11.50	.472	11.68
.514	11.50	.442	11.50	878.363	11.50	.503	11.59
725.397	11.50:	789.338	11.57	.388	11.59	200.427	11.59
.436	11.68	823.394	11.50	.413	11.65	.453	11.63
.473	11.88	5109.388	11.49	.438	11.71	.483	11.37
.483	11.78	.436	11.59	.463	11.73	.509	11.59
.486	11.68	.470	11.62	.486	11.71	227.532	11.50
.493	11.68	.507	11.68	.510	11.62	262.445	11.68:
.500	11.70	110.407	11.68	.535	11.60	286.384	11.73:
.507	11.68	.435	11.66	879.351	11.85	.410	11.68
757.357	11.68	.470	11.59	.376	11.77	.435	11.55
760.431	11.50	.500	11.42	.404	11.58	.456	11.62
.468	11.64	111.506	11.59	.431	11.62	287.344	11.68
.494	11.64	.524	11.73	.457	11.60	.374	11.62
.501	11.80:	112.459	11.68	.482	11.55	.412	11.62
.508	11.77:	.491	11.64	.511	11.56	288.333	11.68
.515	11.82	.525	11.64	880.341	11.59	.363	11.67
.522	11.70	139.441	11.60	.365	11.46	.388	11.68

Table 2 (cont.)

JD_{hel} 244..	B	JD_{hel} 244..	B	JD_{hel} 244..	B	JD_{hel} 244..	B
6289.414	11.61	6554.494	11.57	6623.410	11.57	6997.429	11.62
291.305	11.62	.520	11.68	.434	11.53	998.325	11.48
.339	11.70	.545	11.63	.457	11.59	.345	11.53
293.366	11.70	.568	11.88	.481	11.68	.373	11.63
.392	11.68	.589	11.76	.505	11.71	.397	11.66
294.349	11.73	557.536	11.83	.530	11.65	7000.369	11.58
.375	11.59	.538	11.84	625.512	11.73	003.365	11.56
.400	11.58	.543	11.85	.536	11.62	032.368	11.70
295.348	11.50	.546	11.83	626.429	11.62	.394	11.63
.373	11.50	583.493	11.83	.449	11.73	033.324	11.56
.398	11.62	586.536	11.42	.498	11.68	.357	11.48
296.357	11.68	.561	11.50	.525	11.67	.420	11.61
.382	11.62	587.368	11.78	645.403	11.57	034.384	11.78
.408	11.68	.392	11.68	671.364	11.58	.405	11.80
317.328	11.68	.418	11.62	.381	11.56	038.345	11.52
.353	11.62	.432	11.57	672.308	11.50	040.432	11.40
320.373	11.42	.453	11.47	.331	11.62	054.309	11.65
321.310	11.68	.477	11.57	.383	11.68	.332	11.56
345.234	11.62	588.483	11.85	.419	11.89	055.328	11.70
.266	11.85	.531	11.68	.432	11.78	.324	11.58
554.441	11.57	.563	11.50	880.590	11.88	.349	11.51
.469	11.50	601.453	11.90	.600	11.82	056.374	11.58
.491	11.54	618.412	11.54	997.400	11.62		

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UBVR OBSERVATIONS AND NEW ELEMENTS FOR THE DOUBLE-MODE CEPHEID EW Sct

Photoelectric observations of the double-mode Cepheid EW Sct were carried out in summer-autumn 1991. The 60-cm reflector of the Mt. Maidanak observatory of the Tashkent Astronomical Institute was used and 81 UBVR measurements (Table 1) were obtained.

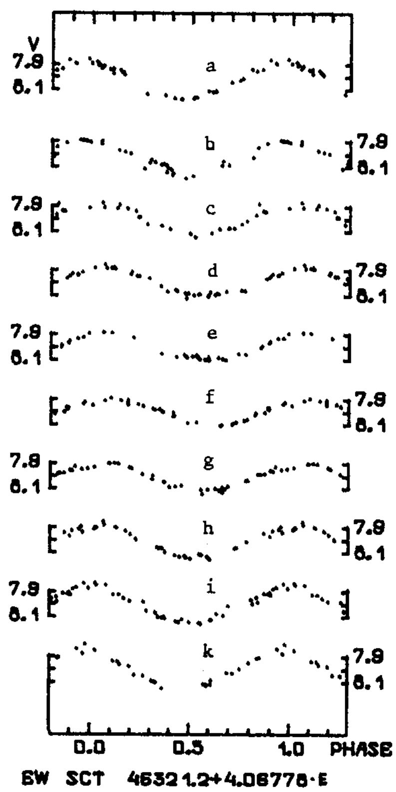

Figure 1

The light curves of double-mode Cepheid EW Sct with period P(1) in different phase intervals of period P(0):
0-0.1 (a), 0.1-0.2 (b), 0.2-0.3 (c), 0.3-0.4 (d), 0.4-0.5 (e),
0.5 - 0.6 (f), 0.6-0.7 (g), 0.7-0.8 (h), 0.8-0.9 (i) and 0.9-1.0 (k)

Table 1

JD hel 2448000+	V	U–B	B–V	V–R	JD hel 2448000+	V	U–B	B–V	V–R
418.4566	7.897	1.361	1.691	1.567	479.3143	8.194	–	1.898	1.681
419.3898	7.854	1.339	1.737	1.542	480.2405	8.235	1.516	1.822	1.678
420.3850	7.868	1.395	1.746	1.605	481.2696	7.946	1.342	1.687	1.590
425.4088	7.921	1.381	1.741	1.598	482.2729	7.865	–	1.686	1.576
426.3508	8.128	1.472	1.832	1.648	484.2437	8.007	1.409	1.758	1.614
427.3879	8.209	1.505	1.826	1.665	485.2175	7.984	1.428	1.756	1.615
428.3896	8.039	1.362	1.740	1.537	486.2174	8.079	1.493	1.788	1.648
429.4016	7.891	–	1.708	1.571	487.2075	8.152	1.487	1.803	1.656
430.3802	7.929	1.371	1.723	1.573	488.1834	7.837	1.338	1.648	1.551
436.3674	7.665	–	1.591	1.501	489.2084	7.735	1.350	1.630	1.537
437.3780	7.913	–	1.745	1.587	490.2253	7.935	1.438	1.728	1.610
438.3748	8.171	–	1.850	1.721	491.2338	8.194	1.576	1.884	1.669
439.3599	8.259	–	1.849	1.690	493.2133	7.851	1.349	1.670	1.553
440.3647	8.001	–	1.722	1.594	498.2444	8.043	1.451	1.774	1.620
443.3258	8.012	–	1.762	1.610	499.2183	8.053	1.438	1.766	1.620
444.3185	8.020	–	1.781	1.616	503.2047	8.191	–	1.853	1.689
445.3226	8.039	–	1.789	1.615	504.2192	8.247	–	1.838	1.669
448.3133	7.720	1.310	1.629	1.517	505.1814	7.800	–	1.642	1.542
449.3679	7.898	–	1.737	–	506.1804	7.752	–	1.652	–
451.3084	8.284	–	1.875	1.680	507.2121	8.023	–	1.775	1.637
453.3259	7.774	1.370	1.640	1.537	508.2044	8.163	1.514	1.843	1.667
454.3407	7.982	–	1.763	1.606	509.1937	8.124	–	1.804	–
455.3470	8.086	–	1.806	–	510.1872	7.967	–	1.727	1.596
456.3415	8.091	–	1.783	1.629	511.1925	7.959	–	1.729	1.600
457.3451	8.020	–	1.771	1.613	512.1997	7.892	1.379	1.696	1.580
458.3158	8.052	1.442	1.768	1.618	513.1875	7.881	–	1.694	–
459.2750	7.891	1.349	1.700	1.565	514.1820	7.947	1.415	1.750	1.603
460.3452	7.785	1.317	1.676	1.541	515.1931	8.162	1.493	1.829	1.677
461.2821	7.903	–	1.739	1.589	516.1923	8.204	–	1.829	1.665
462.2919	8.205	1.483	1.840	1.698	517.1863	7.746	–	1.635	1.517
463.2567	8.249	1.539	1.836	1.640	518.2007	7.765	–	1.631	1.550
464.2640	7.913	1.332	1.676	1.539	520.1851	8.224	–	1.850	1.681
465.3253	7.726	1.322	1.618	1.502	521.1427	8.179	–	1.814	1.660
466.3234	7.968	–	1.777	1.605	522.1434	7.885	–	1.687	1.571
467.3220	8.172	–	1.835	1.664	523.1808	7.888	–	1.695	1.575
472.3820	7.811	1.508	1.680	1.549	536.1421	8.037	1.422	1.777	1.641
473.3265	7.917	1.398	1.716	1.567	537.1260	8.106	1.438	1.789	1.642
474.3175	8.127	1.535	1.754	1.632	541.1507	7.810	1.325	1.648	1.547
475.3035	8.186	1.570	1.791	1.632	542.1124	7.811	1.339	1.670	1.560
477.2465	7.704	1.295	1.594	1.508	543.1275	8.014	1.446	1.761	1.632
478.2428	7.984	1.452	1.744	1.559					

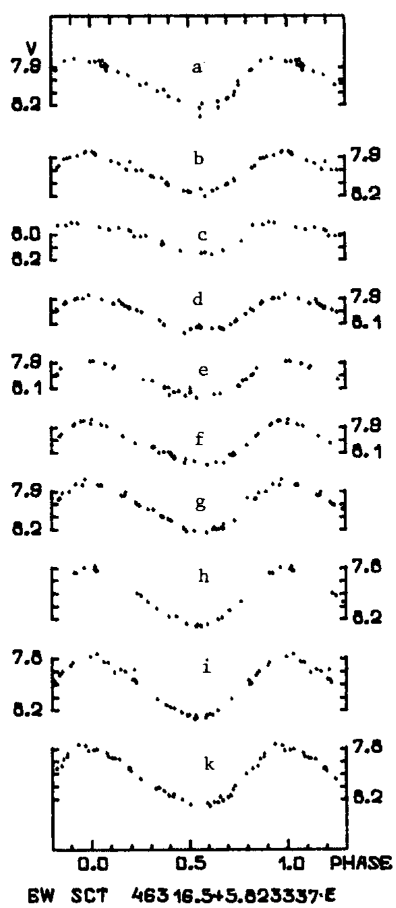

Figure 2

The light curves of double-mode Cepheid EW Sct with period P(0) in different phase intervals of period P(1):
0-0.1 (a), 0.1-0.2 (b), 0.2-0.3 (c), 0.3-0.4 (d), 0.4-0.5 (e),
0.5-0.6 (f), 0.6-0.7 (g), 0.7-0.8 (h), 0.8-0.9 (i) and 0.9-1.0 (k)

These observations together with the other published ones (Berdnikov, 1992, Figer et al., 1991) allow to improve the periods using the method described by Antonello et al. (1986). The new elements are:

$$\text{Max (0)} = \text{JD hel } 2446316.5 + 5^{d}.823337\ E, \text{ and}$$

$$\text{Max (1)} = \text{JD hel } 2446321.2 + 4^{d}.06778\ E.$$

The observed magnitudes converted into intensities were then expressed as a sum of two oscillations, and light curves of each oscillation were constructed for different phase intervals of the other oscillation. These curves in V band are presented in Figures 1 and 2.

A detailed investigation of the light curves of EW Sct in UBVR bands will be published elsewhere.

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UBVR OBSERVATIONS AND NEW ELEMENTS FOR THE DOUBLE-MODE CEPHEID AS Cas

Photoelectric observations of the double-mode Cepheid AS Cas were carried out in summer-autumn 1991. The 60-cm reflector of the Mt. Maidanak ob-

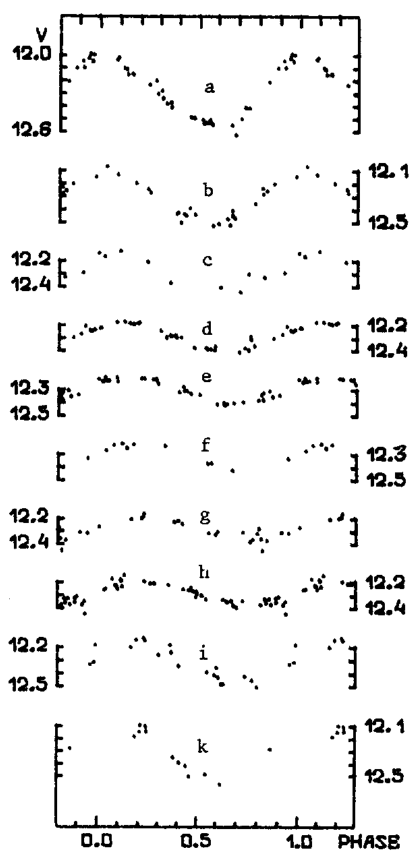

Figure 1

The light curves of double-mode Cepheid AS Cas with period P(1) in different phase intervals of period P (0):
0-0.1 (a), 0.1-0.2 (b), 0.2-0.3 (c), 0.3-0.4 (d), 0.4-0.5 (e), 0.5-0.6 (f), 0.6-0.7 (g), 0.7-0.8 (h), 0.8-0.9 (i), and 0.9-1.0 (k)

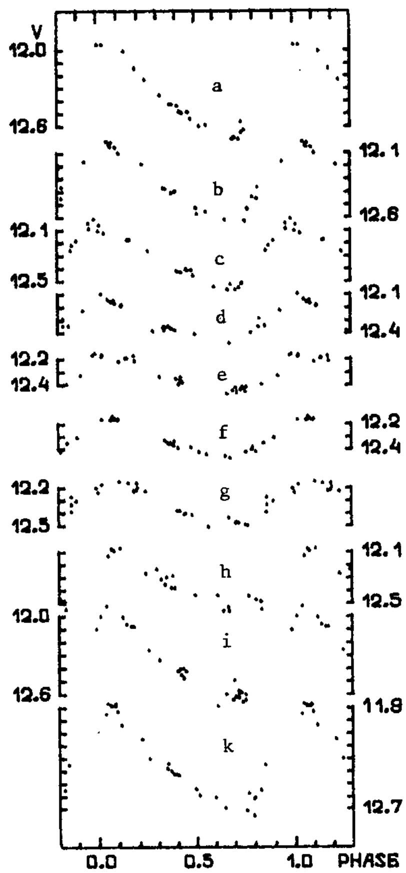

Figure 2

The light curves of double-mode Cepheid AS Cas with period P(0) in different phase intervals of period P(1):
0-0.1 (a), 0.1-0.2 (b), 0.2-0.3 (c), 0.3-0.4 (d), 0.4-0.5 (e), 0.5-0.6 (f), 0.6-0.7 (g), 0.7-0.8 (h), 0.8-0.9 (i), and 0.9-1.0 (k)

servatory of the Tashkent Astronomical Institute was used and 54 UBVR measurements (Table 1) were obtained.

These observations supplemented with those published earlier (Berdnikov, 1992, Henden, 1980) allow to improve the periods using the method described by Antonello et al. (1986). The new elements are:

$$\text{Max (0)} = \text{JD hel } 2448510.14 + 3\overset{d}{.}024675\ E, \text{ and}$$

$$\text{Max (1)} = \text{JD hel } 2448510.5 \ + 2\overset{d}{.}155557\ E.$$

Table 1

JD hel 2448000+	V	U-B	B-V	V-R	JD hel 2448000+	V	U-B	B-V	V-R
444.4515	12.292	-	1.390	1.232	509.4098	12.460	1.021	1.387	1.306
445.4518	12.653	-	1.507	-	510.3942	11.722	-	1.165	1.050
448.4434	12.324	-	1.415	-	511.4153	12.291	-	1.408	1.253
455.4485	12.303	-	1.315	-	512.4168	12.473	-	1.424	-
456.4484	12.160	-	1.291	1.159	513.4157	12.040	-	1.276	-
461.4445	12.006	-	1.236	-	514.4138	12.358	-	1.417	-
462.4542	12.290	-	1.344	-	515.4136	12.342	-	1.343	1.243
463.4484	12.312	-	1.393	1.247	516.3918	12.072	-	1.278	1.128
464.4538	12.339	-	1.367	1.241	517.3929	12.177	-	1.347	1.188
465.4575	11.973	1.283	-	-	520.3843	12.371	-	1.451	1.233
468.4847	12.492	-	1.486	1.330	521.3643	12.414	-	1.374	1.250
477.4503	12.222	-	1.340	1.209	522.2997	12.148	-	1.279	1.195
479.4672	12.297	-	1.442	1.242	523.3380	12.228	-	1.337	1.225
482.4514	12.147	-	1.295	1.183	533.3595	12.491	-	1.483	1.304
485.4161	12.186	-	1.312	1.202	537.3231	12.112	0.887	1.279	1.165
487.4259	12.309	0.800	1.401	1.250	541.3980	12.268	-	1.376	1.242
490.4165	12.471	0.968	1.448	1.310	542.2482	12.467	1.133	1.464	1.260
491.3749	12.190	0.923	1.303	1.221	543.2920	11.864	0.977	1.173	1.094
494.3835	12.392	-	1.422	1.254	551.2763	12.454	-	1.478	1.267
498.3969	12.111	-	1.287	1.202	552.2750	12.139	-	1.265	1.198
499.3389	12.349	0.935	1.416	1.270	553.2429	12.200	-	1.300	1.200
503.3517	12.551	-	1.454	1.297	556.2820	12.090	-	1.325	1.163
504.3758	11.867	-	1.217	1.128	557.2307	12.573	-	1.443	1.342
505.4105	12.469	-	1.443	1.298	559.2501	12.256	-	1.383	1.211
506.4245	12.267	-	1.324	-	560.2376	12.324	-	1.387	1.202
507.4144	12.189	-	1.327	-	561.2585	12.327	0.940	1.346	1.235
508.3909	12.254	-	1.288	1.236	562.2889	12.029	0.897	1.258	1.174

The observed magnitudes converted into intensities were then expressed as a sum of two oscillations, and light curves of each oscillation were constructed for different phase intervals of the other oscillation. These curves in V band are presented in Figures 1 and 2.

A detailed investigation of the light curves of AS Cas in UBVR bands will be published elsewhere.

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References:

Antonello, E., Mantegazza, L. and Poretti, E.: 1986, Astron. Astrophys., 159, 269.
Berdnikov, L.N.: 1992, submitted for publication.
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NEW ELEMENTS AND LIGHT CURVES OF THE DOUBLE-MODE CEPHEID V367 Sct

Nearly 300 published photoelectric observations of the double-mode Cepheid V367 Sct (Berdnikov, 1986, 1992; Dean, 1977; Madore et al., 1978; Madore and van den Bergh, 1975; Moffett and Barnes, 1984) were used for redetermination of the periods using the method described by Antonello et al. (1986). The new elements are:

$$\mathrm{Max}\ (0) = \mathrm{JD\ hel}\ 2437430.58 + 6^{\mathrm{d}}.29308\ E, \text{ and}$$

$$\mathrm{Max}\ (1) = \mathrm{JD\ hel}\ 2437430.26 + 4^{\mathrm{d}}.38484\ E.$$

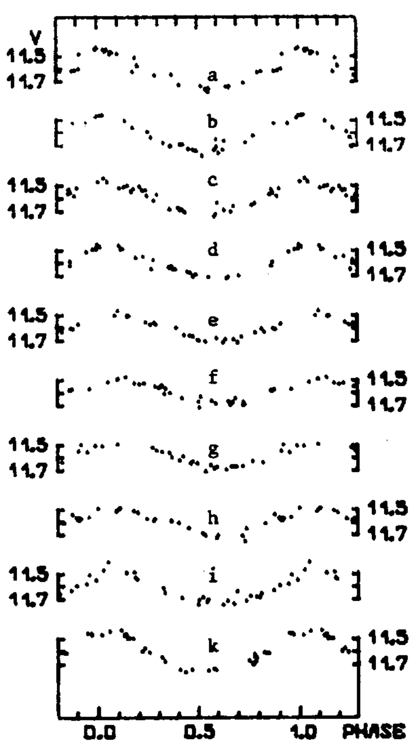

Figure 1

The light curves of double-mode Cepheid V367 Sct with period P(1) in different phase intervals of period P(0):
0–0.1 (a), 0.1–0.2 (b), 0.2–0.3 (c), 0.3–0.4 (d), 0.4–0.5 (e), 0.5–0.6 (f), 0.6–0.7 (g), 0.7–0.8 (h), 0.8–0.9 (i) and 0.9–1.0 (k)

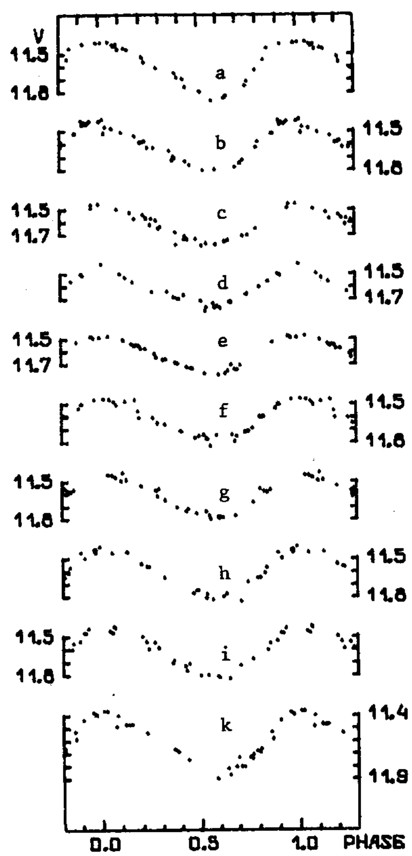

Figure 2

The light curves of double-mode Cepheid V367 Sct with period P(0) in different phase intervals of period P(1):
0–0.1 (a), 0.1–0.2 (b), 0.2–0.3 (c), 0.3–0.4 (d), 0.4–0.5 (e),
0.5–0.6 (f), 0.6–0.7 (g), 0.7–0.8 (h), 0.8–0.9 (i), and 0.9–1.0 (k)

All magnitudes converted into intensities were then expressed as a sum of two oscillations, and light curves of each oscillation were constructed for different phase intervals of the other oscillation. These curves in V band are presented in Figures 1 and 2.

A detailed investigation on the light curves of V367 Sct in UBVR bands will be published elsewhere.

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References:

Antonello, E., Mantegazza, L. and Poretti, E.: 1986, Astron. Astrophys., 159, 269.
Berdnikov, L.N.: 1986, Perem. Zvezdy, 22, 369.
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1990 AND 1991 UBVRI PHOTOMETRY OF FK COMAE

During 1988 and 1989, Heckert and Maloney (1992) performed UBV photometry of FK Comae Berenices (HD 117555), the prototype star of the FK Comae class of variable stars. We continue this work with 1990 and 1991 UBVRI photometry.

We did the photometry on 10 nights between 13 and 30 May 1990, and on 13 nights in 1991 between 7 and 9 March and between 12 and 26 May. We used the 0.6m telescope at Mount Laguna Observatory operated by San Diego State University. The photometer used a different tube from that used for the 1988 and 1989 observations. The new tube was a Hamamatsu GaAs tube operated at -1450V. We usually used a 19" aperture but used larger apertures as seeing required. Data were transformed to the standard Johnson-Cousins UBVRI system. HD 117567 was the comparison star, and HD 117876 was the check. We find no evidence for variability in the comparison star. For reasons discussed by Heckert and Maloney (1992), we used c=2442192.345 + 2.400E (Chugainov 1976) to calculate the phases.

Flares are often observed on FK Com. Morris and Milone (1983) observed several flares on FK Com. Heckert and Maloney (1992) also observed a flare during 1989. Our practice of averaging nightly observations from a short time period into a single nightly point makes it difficult to distinguish flares; however, we observed another flare during 1991. The U-B point at phase 0.64 in our 1991 data is about 0.15 magnitudes brighter than the other points on that part of the light curve(Figure 3). This point is only about 0.05 magnitudes too bright at B-V and V (Figures 1 & 2). At V-R and V-I there appears to be no significant increase in brightness (Figure 4). These data were taken on the night of 21 May 1991 UT at about 09:15 UT under excellent sky conditions. The color behavior of this flare is similar to that observed in the previous flares. The flare is brightest at U, much less so at V, and insignificant at R and I. Morris and Milone (1983) note that all five flares reported up to the time of their work occurred between phases 0.4

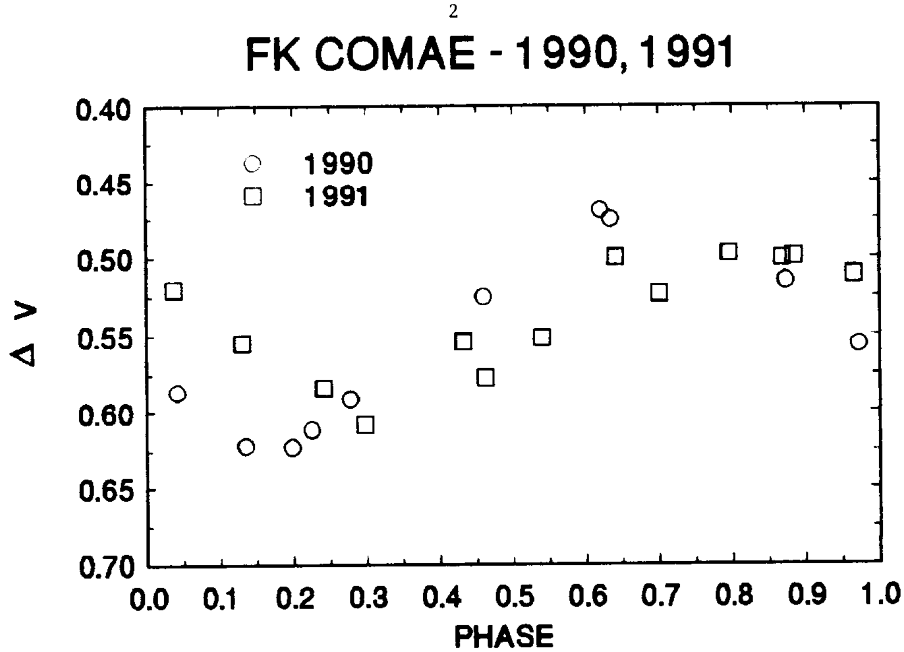

FIGURE 1

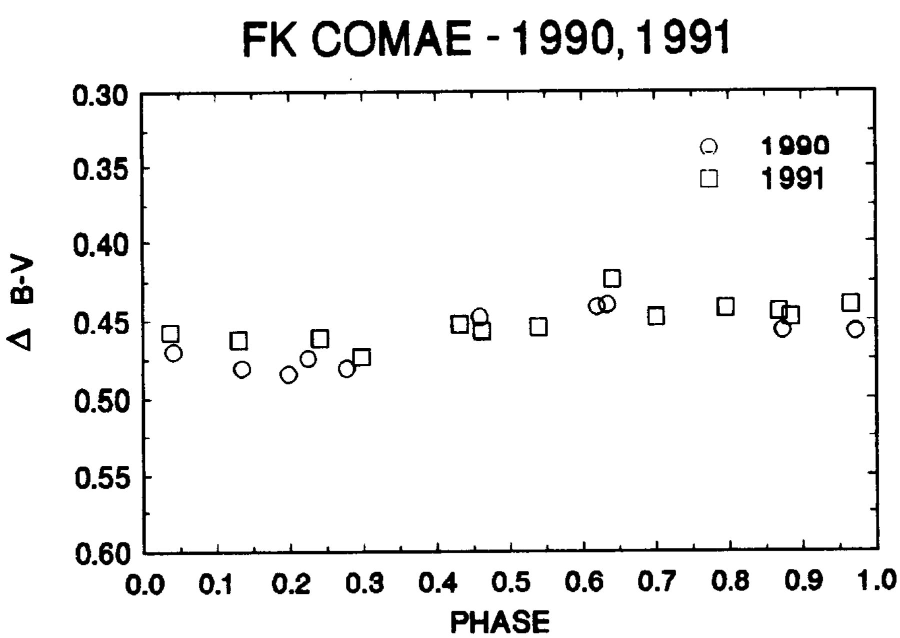

FIGURE 2

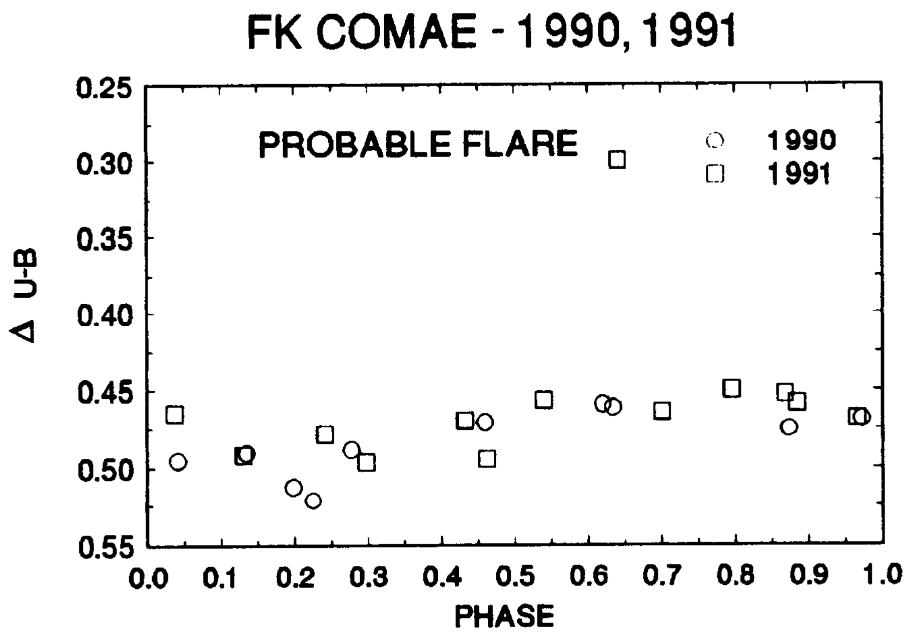

FIGURE 3

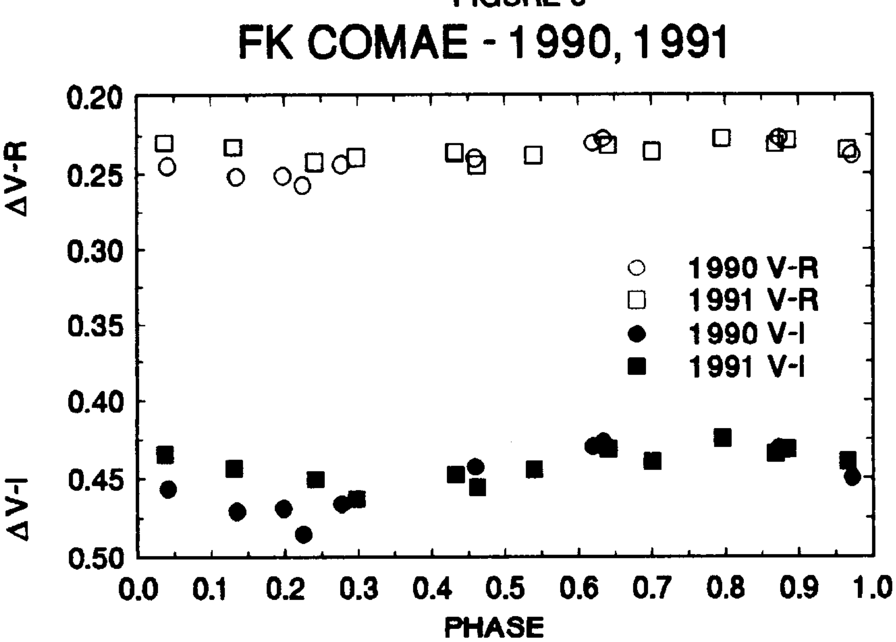

FIGURE 4

and 0.9. The 1989 and 1991 flares at phases 0.5 and 0.64 continue this trend. We have no information about the total energy or duration of the flare. We do however remove this point when considering the nonflare behavior of FK Com below.

We plot our V differential magnitudes in Figure 1. The phase of minimum light is about 0.17 in 1990 and about 0.3 to 0.35 in 1991. These results compare to the phases of minimum light of about 0.6 in 1988 and about 0.15 in 1989 (Heckert and Maloney 1992). The amplitude of variation is about 0.15 magnitudes for 1988, 1989, and 1990 (with small year to year fluctuations) and about 0.11 magnitudes in 1991. The level of light at maximum is about the same for both 1988, 1989, and 1991. It is about 0.02 magnitudes brighter in 1990.. From this information we conclude, in the context of the starspot model, that the major spot or spot group either migrated significantly in longitude or disappeared and reformed at a new longitude between 1988 and 1989. The spot then migrated an insignificant amount between 1989 and 1990 and the migration rate increased from 1990 to 1991. The migration is in the sense of increasing phase. In addition, the area covered by the major spot fluctuated a small amount from 1988 to 1990 and then decreased in 1991. From the levels of maximum light we conclude that there were smaller spots spread around the star that disappeared or decreased in 1990. The color curves generally show minima and maxima at the same phases as the V light curves. The star is reddest at minimum light as would be expected if cool spots cause the brightness variations.

Ron Angione scheduled generous amounts telescope of time at Mt. Laguna for this work. We also acknowledge support from The Research Corporation.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 3714

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Budapest
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VARIABILITY IN THE MINIMA DEPTH OF THE DOUBLE SYSTEM HD 135421

BV Dra and BW Dra (ADS 9537, HD 135421) were detected as eclipsing binaries in 1965 by Batten and Hardie. Photometric observations by Wood (1970), Rucinski (1976) and Yamasaki (1979) have shown that they are normal W UMa systems. New photometric observations have been presented by Rovithis and Rovithis (1987) for the system. Dapergolas et al. (1989a, b) and Dapergolas et al., 1990 have also carried out BV photoelectric observations of BV Dra and BW Dra respectively.

These two eclipsing binaries were observed from 19 May through 21 May 1991 with the 1.2m Kryonerion telescope and a single channel photon counting photometer. The photometer employs a high gain 9789QB phototube and conventional BV filters. Its output is fed directly to a microcomputer enabling rapid data access.

The data reduction is the standard one. The comparison star is for both cases BD +62° 1385 and the accuracy of observations is 0.02 mag.

Table I lists the dates of observations and phases covered whereas Figures 1 and 2 summarize the results for B and V colours.

Table I

BV Dra		BW Dra	
Date	Phase	Date	Phase
19 May 1991	.70 - .31	19 May 1991	.21 - .94
20 May 1991	.45 - .16	20 May 1991	.49 - .34
21 May 1991	.39 - .03	21 May 1991	.01 - .75

In Table II the times of minima and the O-C values are listed for the V and B bands respectively.

Times of minima are calculated using the method described by Kwee and van Woerden (1956) whereas the O-C values were determined from the following linear ephemerides:

BV Dra T = 2442878.372 +0^{d}.3500663 E (Geyer et al., 1982).

BW Dra T = 2442572.538 +0^{d}.2921671 E (Geyer et al., 1982).

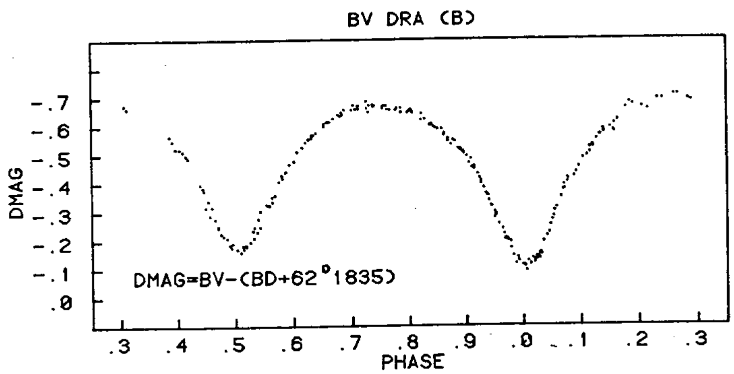

Figure 1a

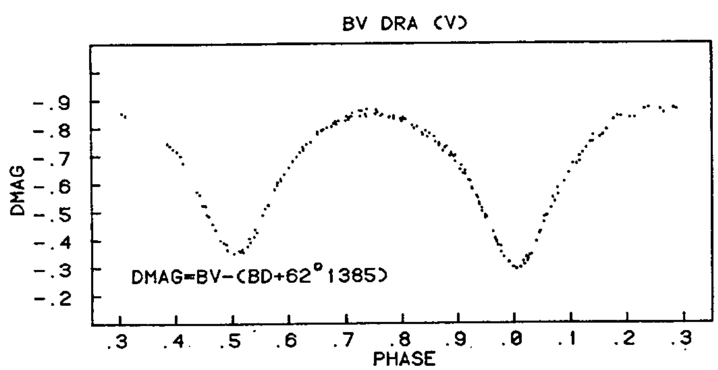

Figure 1b

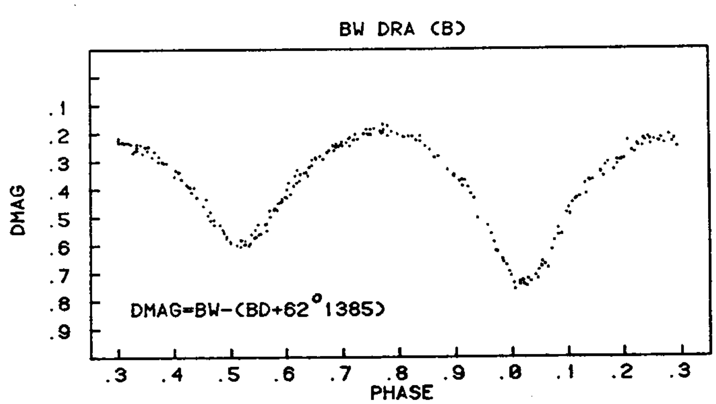

Figure 2a

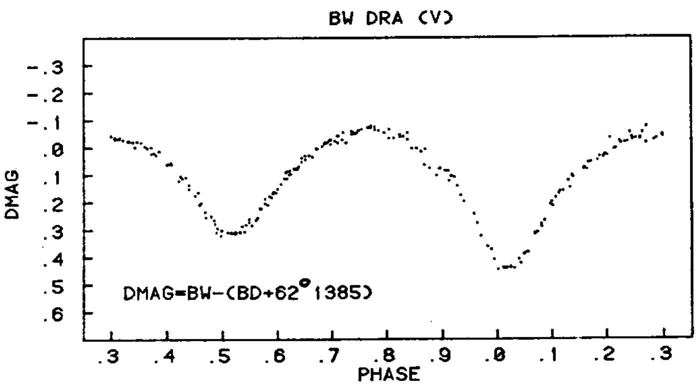

Figure 2b

Table II

a) BV Dra

Type of minima	V colour Heliocentric Jul. Day	(O-C) Phase	B colour Heliocentric Jul. Day	(O-C) Phase
Primary	2448396.4684	0.0038	2448396.4684	0.0039
	±.0002	±.0005	±.0003	±.0009
Secondary	2448397.3447	0.5071	2448397.3439	0.5046
	±.0002	±.0004	±.0003	±.0008
Primary	2448397.5187	0.0041	2448397.5187	0.0041
	±.0002	±.0006	±.0002	±.0006
Secondary	2448398.3948	0.5038	2448398.3953	0.5083
	±.0001	±.0002	±.0001	±.0003

a) BW Dra

Type of minima	V colour Heliocentric Jul. Day	(O-C) Phase	B colour Heliocentric Jul. Day	(O-C) Phase
Secondary	2448396.4541	0.518	2448396.4552	0.5215
	±.0003	±.001	±.0002	±.0007
Primary	2448397.4781	0.0228	2448397.4782	0.0229
	±.0002	±.0007	±.0002	±.0007
Secondary	2448398.5002	0.5211	2448398.4997	0.519
	±.0002	±.0007	±.0003	±.001

Table III

Differences between the amplitudes of Primary and Secondary minima for BW Dra in B, V colours

Date	ΔB(mag)	ΔV(mag)
1991	0.13	0.13
1990	0.18	0.17
1989	0.11	0.10
1982	0.13	0.12
1981	0.07	0.07
1980	0.06	0.05

Figures 1a and b show the light curve of BV Dra for B, V colours respectively whereas Figure 2a and b is the same for BW Dra.

From Fig. 1a,b and Fig. 2a,b it can be seen that BV Dra and BW Dra have nearly symmetric light curves.

The difference between primary and secondary minima is $\approx$ 0.13 mag in B and V for BW Dra whereas for BV Dra we measure 0.07 mag for B and V.

From the observations presented previously by Dapergolas et al. (1989b), Rovithis and Rovithis (1987) and Geyer et al. (1982) it is found that the difference between the amplitudes of primary and secondary minima varies from year to year (see Table III) and does not change from colour to colour for BW Dra.

This variation from year to year is not found for BV Dra.

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COMMISSIONS 27 AND 42 OF THE IAU
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HD 13654: a new spectroscopic and eclipsing double-line binary of large RV_{lsr}

HD 13654 ($\alpha_{2000} = 2^h15^m11^s.8, \delta_{2000} = +59°20'50"$) belongs to the field of the open cluster Stock 2, but it is not a cluster member according to its spectroscopic parallax (230 pc) and radial velocity (<RV>=44 km sec^{-1}) (Munari 1992a). HD 13654 has captured little attention in the past. Some photometry and spectral classification on objective prism plates can be found in a number of papers dealing with Stock 2 (Stock 1956, Brodskaya & Shajn 1958, Krzeminski & Serkowski 1967, Martini 1971, McCuskey 1974), which give for HD 13654 <V>=9.86 and an early A spectral type.

HD 13654 has been extensively observed with the Boller & Chivens + CCD spectrograph at the 1.8 m telescope of the Asiago Astrophysical Observatory during a long term spectroscopic investigation of the Stock 2 cluster (Munari 1992a). 10 spectra have been recorded at resolution of 1 and 2 Å/pixel (40 and 80 Å/mm) over the period February 1990 - December 1991. A journal of the observations is given in Table 1. Following the procedure described in detail by Munari (1992b), each spectrum was classified by comparison with a library of reference spectra of MKK standards observed with the same instrument and dispersion, and their RVs were determined by cross-correlation techniques. As template stars we used the Stock 2 cluster non-binary members HD 13518, HD 13688, HD 13909, HD 14025 and HD 14161, with their RVs taken from Pesch & McCuskey (1974). The measured RVs are reported in Table 1. It can be seen that HD 13654 presents a large RV variation, indicative of binarity and large orbital inclination. No obvious orbital period has been found from a Fourier analysis the data, which are probably too few to this aim.

Nine of the ten HD 13654 spectra we recorded turned out to be very similar, giving a spectral classification of A2.6($\pm$0.1) V (see Figure 2a). The spectrum secured on 28.09.1990 showed instead a G9 star continuum (see Figure 2b). The sudden change was immediately recognized during preliminary on-line analysis of

Table 1: Journal of observations

Date	grating ln mm^{-1}	scale (Å/pixel)	range ($\lambda\lambda$ Å)	RV (km/sec)	JD (+2440000)
18.02.90	1200	1	3850-4400	+33	7941.311
28.09.90	600	2	3790-4910		8163.390
14.10.90	600	2	3790-4910	+51	8179.370
08.01.91	600	2	3790-4910	+1	8265.243
25.01.91	600	2	3790-4910	+141	8282.259
26.01.91	600	2	3790-4910	+75	8283.241
20.10.91	1200	1	3850-4400	+21	8551.455
17.12.91	1200	1	3850-4400	+25	8608.386
18.12.91	1200	1	3850-4400	+10	8609.379
19.12.91	1200	1	3850-4400	+34	8610.246

Table 2: UBV and RGU magnitudes of comparison stars

Star	UBV			RGU		
	V	U	B	G	R	U
A	8.74	9.53	9.18	9.40	8.83	9.83
B	8.93	11.46	10.31	9.96	8.49	11.46
C	9.29	11.24	10.30	9.98	9.01	11.31
D*	9.94	12.37	11.31	10.85	9.43	12.31
E	10.66	11.70	11.24	11.20	10.38	11.80
F‡	11.94	12.72	12.76	12.48	11.32	12.63
G	12.81	14.45	13.82			
H*	14.18	16.74	15.66			
I*	14.70	16.03	15.62			

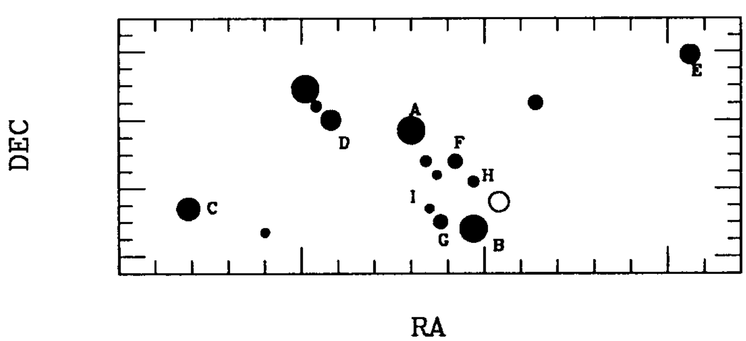

Figure 1. Identification chart for HD 13654 and comparison stars in Table 2.

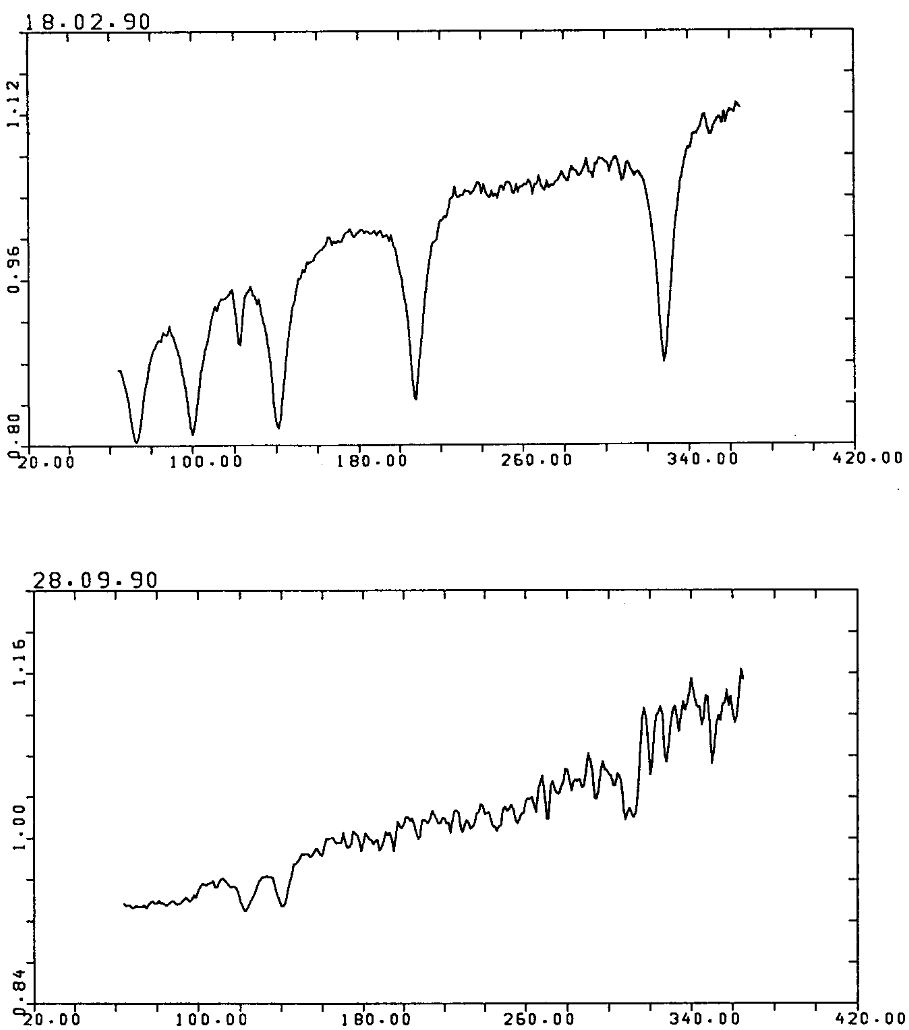

Figure 2. Spectra of HD 13654: *top* = outside eclipse; *bottom* = in eclipse

the data at the telescope and the star identification was carefully controlled, so the change in spectral type has been *real.*

The large RV variation and the spectrum change recorded on 28.09.1990 suggest that HD 13654 is an *eclipsing* spectroscopic binary. A test spectrum secured out of eclipse in the 7000-9000 Å region with the equipment above described, showed absorption lines assignable to the G9 companion. Being an eclipsing system, the determination of the orbits of the two components would immediately give their masses. What makes HD 13654 still more interesting is its relatively large RV in the Local Standard of Rest: RV_{lsr}=+48 km sec^{-1} , much more than expected from A type stars belonging to the young thin-Disk of the Galaxy (Freeman 1987).

Clearly, HD 13654 is worth of a detailed investigation. It is relatively bright and lies at only 2° from the h and χ double cluster in Perseus. This makes it a worth object to search in plate archive and to be observed by amateur astronomers. For this reason a finding chart (Figure 1) and a photometric comparison sequence (Table 2) are given here. The UBV photometry is the mean of the values reported by Krzeminski & Serkowski (1967) and Martini (1971) and it should be accurate to 0.017 mag (0.024 for stars marked by * which were not observed by Martini 1971). The RGU photometry is from Stock (1956). Star F has anomalous colors but no record of variability.

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COMMISSIONS 27 AND 42 OF THE IAU
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HU ISSN 0374 - 0676

V 2101 Oph AND V598 Sco: TWO MISCLASSIFIED U Gem IN THE SOUTHERN HEMISPHERE

Both V2101 Oph and V598 Sco are classified as U Gem stars in the 1985 edition of the GCVS.

Vogt et al. (1982 *Astron. Astrophys., Suppl.* 48,383) confirm V2101 Oph as a UG in their atlas of southern dwarf novae on the basis of an enhancement of its brightness detected on two subsequent plates of the Palomar Observatory Sky Survey. The same outburst was also detected on a ESO plate (see also Terzan et al. 1988 *Astron. Astrophys. Suppl.* 76,205).

V598 Sco was discovered by H.H. Swope (1943 *Harv. Ann.* 109) and later reported by Petit (1960 *J. Obs.*, 43,17) in his catalogue of dwarf novae where five outbursts of the star are recorded.

These stars have been included in a program for systematic monitoring of northern and southern DNe.

During a six-days run in La Silla (Chile) with the 1.52 m ESO telescope equipped with a *Boller & Chivens* spectrograph, both stars have been observed.

On March 30*th* 1992, V2101 Oph appeared much brighter than at quiescence ($m_V = 16$). Compared with some standard stars in the field of view, the star seemed as bright as $m_V = 13$. This value is very close to the maximum brightness reported by GCVS ($m_{V_{(Max)}} \simeq 12.5$).

Three grating spectra taken in the same night(range 4010 - 5998 Å, 2 Å resolution) showed a late - type spectrum with strong TiO bands.

The spectrum observed the following night did not change and might fit an M5 II - III type.

On March 30*th* 1992, V598 Sco was in its quiescent state with an apparent magnitude of approximately $m_V = 17$.

The following night it appeared brighter, very close to the maximum value of $m_V = 14$, and we obtained two consecutive spectra.

Also in this case we found a late type spectrum that can be classified as K5 II.

Thus both V2101 Oph and V598 Sco are not U Gem stars but more likely, semi-regular late type giants (SR - type).

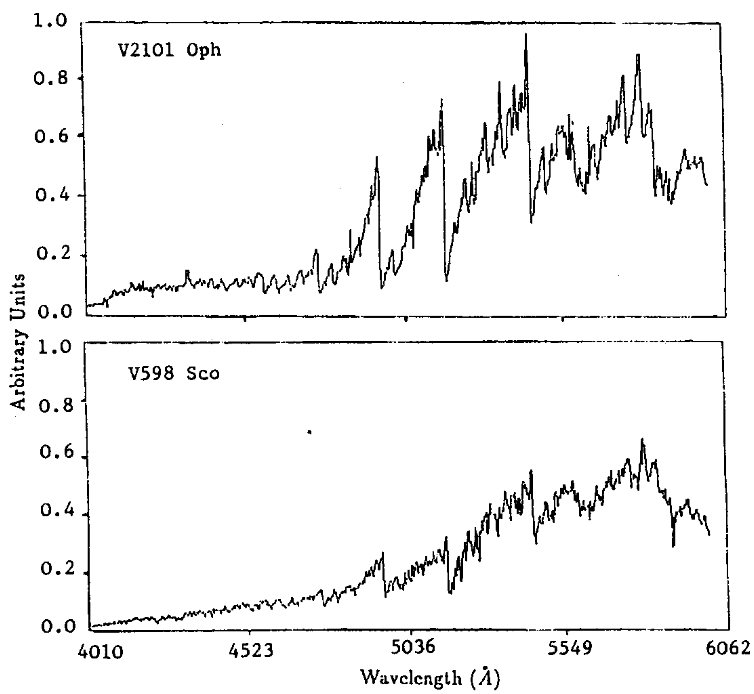

Fig 1: The spectra of V2101 Oph and V598 Sco suggest M5 II – III and K5 II types, respectively.

The two spectra are shown in Fig 1.

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Number 3717

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HU ISSN 0324 - 0676

1990 AND 1991 UBVRI PHOTOMETRY OF HD 199178 = V1794 Cyg

HD 199178, an FK Comae star of spectral class G5 III-IV, has been previously studied by Bopp et al. (1983) and Houvelin et al. (1987). We performed new photometry on 6 nights between 16 May and 26 May 1990 and on 11 nights between 12 May and 26 May 1991.

We used the 24 inch telescope at Mount Laguna Observatory, which is operated by San Diego State University. The photometer has a Hamamatsu GaAs phototube, operating at −1450 volts, and a standard UBVRI filters. SAO 50313 was our comparison star, and SAO 50326 was our check. We find no evidence for variability in our comparison.

To compute the phase we use:

$$C=2444395.7 + 3^{d}\!.337\times E \text{ (Bopp et al. 1983).}$$

Our V light curves (Figure 1) show that the phase of minimum light migrated from about 0.5 to about 0.8 from 1990 to 1991. The two minima are roughly the same magnitude; however during 1991 the star is brighter at maximum light. The amplitude of variability decreases from about 0.06 mag to about 0.04 mag between 1990 and 1991. Hence, we conclude that the major starspot or spot group both migrated in longitude and shrank between 1990 and 1991.

The color curves are in Figures 2-4. The B−V, V−R and V−I curves generally show minima at minimum light as one would expect if the light variations are caused by cooler dark spots. However, the color variations are small making this interpretation difficult. The U−B curves are quite curious. The 1991 U−B curve is about 0.08 magnitudes brighter than the 1990 curve. It is initially tempting to assume that this color difference is caused by a significant increase in the stellar temperature between 1990 and 1991. The shrinking of the major spot group between 1990 and 1991 would tend to cause the average temperature to increase, but the spot does not appear to have shrunk enough to cause the observed difference in the U−B colors.

What about the colors? For a G5 III star a change of 0.08 magnitudes in U−B would correspond to a change of about 0.04 magnitude in B−V, if the color change were entirely

HD 199178 - 1990, 1991

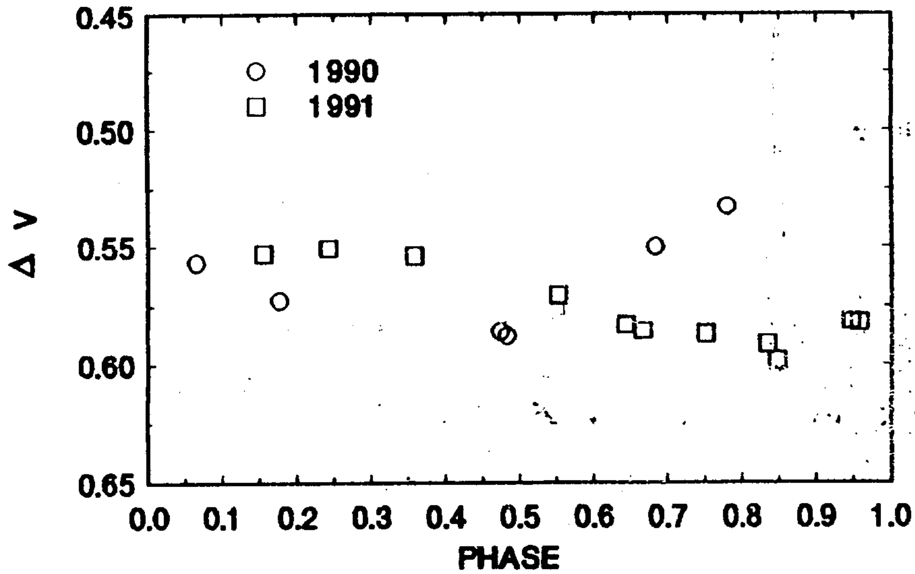

FIGURE 1

HD 199178 - 1990, 1991

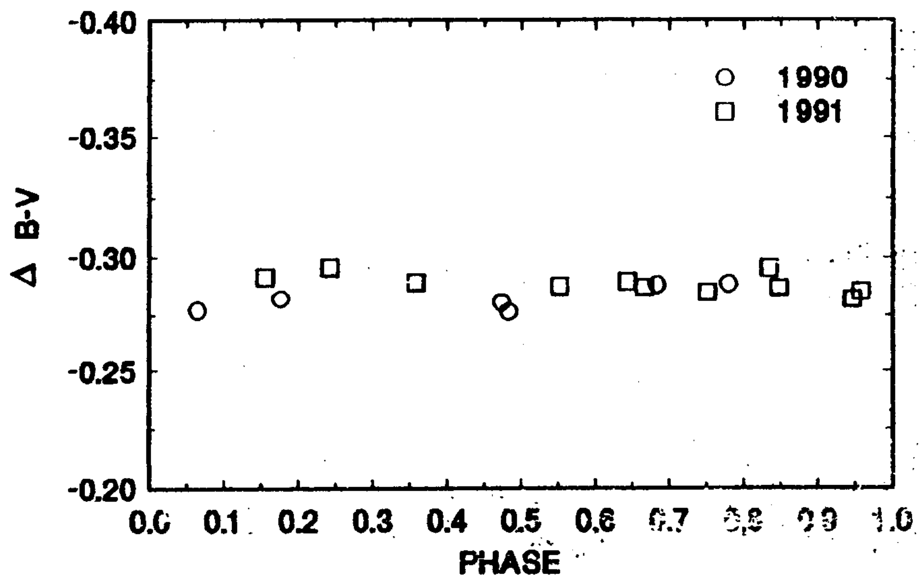

FIGURE 2

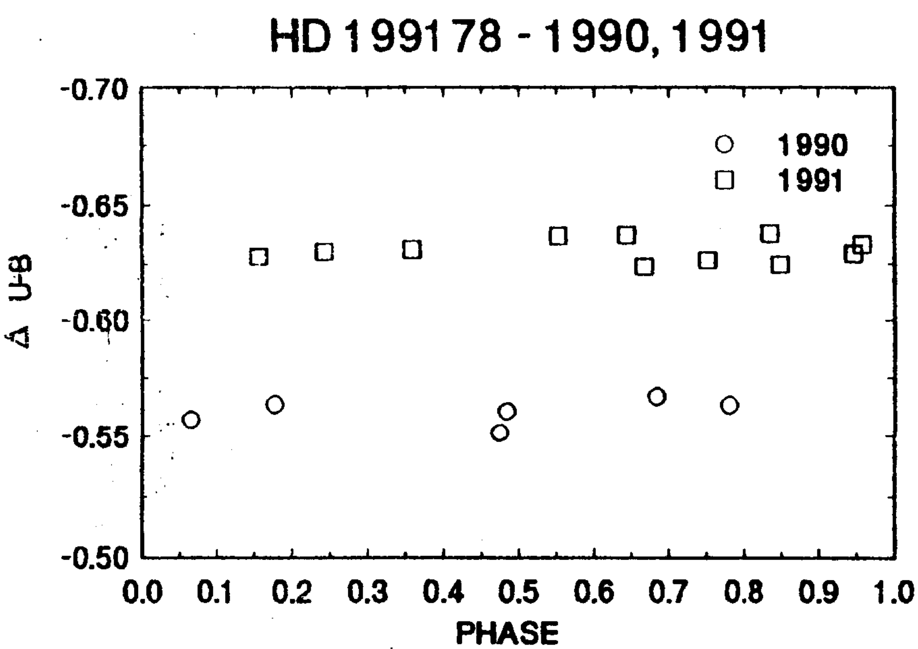

FIGURE 3

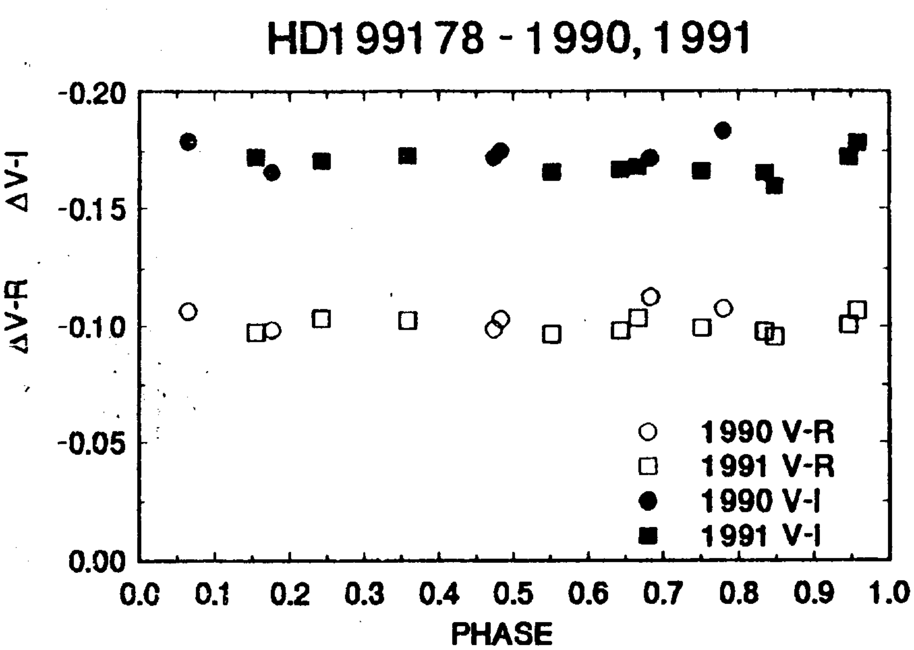

FIGURE 4

caused by a temperature change (Novotny, 1973). Close examination of the B−V color curve shows that the 1991 data are on the average roughly 0.01 to 0.02 magnitudes brighter than the 1990 data. Therefore a temperature change can only partially explain the brightness increase in the U−B color. We do however note that Bopp et al. (1983) observe ultraviolet emission lines in HD 199178; perhaps the effects of changes in the strength of this emission between 1990 and 1991 contribute to the color change.

Ron Angione scheduled generous amounts of time on the Mt. Laguna 24" telescope for this work. The Research Corporation provided generous support for this work.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

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29 April 1992

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NSV 13679: NO ADDITIONAL MINIMUM

D. Hoffleit (1991) reported on the unsuccessful search for minima on more than 200 Harvard patrol plates taken between 1898 and 1921. Schlesinger (1925) had found the star barely detectable ("missing") on one of his Zone Catalogue Allegheny plates (AG 7042 = BD + $49^{\circ}3511$).

There are at least two principal reasons to investigate an "object" like this in some detail:

Firstly, we have indications that among eclipsing variables totally unusual cases exist more frequently than thought hitherto, as for instance objects with strongly varying amplitude (e.g. SS Lac, Lehmann 1991) or with nonstellar components (e.g. BO Cep, Wenzel 1991).

Secondly, in the course of the search for optical counterparts of gamma-ray burst sources the important role of photographic plate defects has come to light (see e.g. Greiner, Wenzel and Degel 1990, Greiner and Wenzel 1991, Hudec 1991).

Therefore I checked the star on 1148 suitable Sonneberg Sky Patrol plates taken mainly by P. Ahnert, H. Huth, and B. Fuhrmann between 1928 and 1990 (except in 1934 and 1935) and additionally on 35 plates of the 400/1600 mm GC astrograph from 1974 to 1982. I found no further minimum. On the contrary, the star seemed remarkably constant at photographic magnitude $9^{m}.1$ in the system of Hoffleit (l.c.). Our investigation can be regarded as a chronological continuation of Hoffleit's data.

After all, I conclude that Schlesinger's finding probably did originate from a plate blemish: Take for the value D/P, the ratio of the duration of minimum to the period of an Algol eclipse curve, the extreme value of 0.01. Then among our more than one thousand fairly uniformly distributed observations about 10 should lie within the domain of the minimum, and some of these should be faint enough to be discernible, even if the minimum is distinctly less deep than 2.5 mag as was suggested by Hoffleit. If there exists a significant secondary minimum, the probability to find the object faint would be still higher.

If we do not prefer to drop this matter and to cancel the star from the list of suspected variables, an investigation of Schlesinger's suspicious plate by means of microscopic techniques such as described by Greiner, Wenzel and Degel (l.c.) might be recommended.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 3719

Konkoly Observatory
Budapest
30 April 1992

HU ISSN 0374 - 0676

1991 BV PHOTOELECTRIC OBSERVATIONS OF CG Cyg

Photometric observations for this star have been reported previously by Zeilik et al., 1991; Dapergolas et al., 1991; Dapergolas et al., 1989a and references therein.

The eclipsing binary CG Cyg was observed for the period 15-26 July with the 1.2m Kryonerion telescope and a single channel photon counting photometer described by Dapergolas and Korakitis (1987). The photometer employs a high gain 9789QB phototube and conventional BV filters. Its output is fed directly to a microcomputer enabling rapid data access.

The data reduction method is the standard one and as a comparison star we used BD $+34^{\circ}4216$. The constancy of the comparison star was verified by Milone et al. (1979). The data presented here were obtained with an accuracy of ± 0.015 mag.

Table I lists the dates of observations and phases covered whereas Figures 1 and 2 summarize the results for B and V colours.

In Table II the times of minima and the O-C values are listed for the V and B bands respectively. Times of minima are calculated using the method described by Kwee and van Woerden (1956), whereas the O-C values were determined from the linear ephemeris $T=2439425^{d}.1221 + 0^{d}.631141E$ given by Milone and Ziebarth (1974).

TABLE I

Date	Phase	
15 July 1991	.61	.97
17 July 1991	.76	.14
19 July 1991	.92	.31
20 July 1991	.46	.76
25 July 1991	.38	.76
26 July 1991	.97	.40

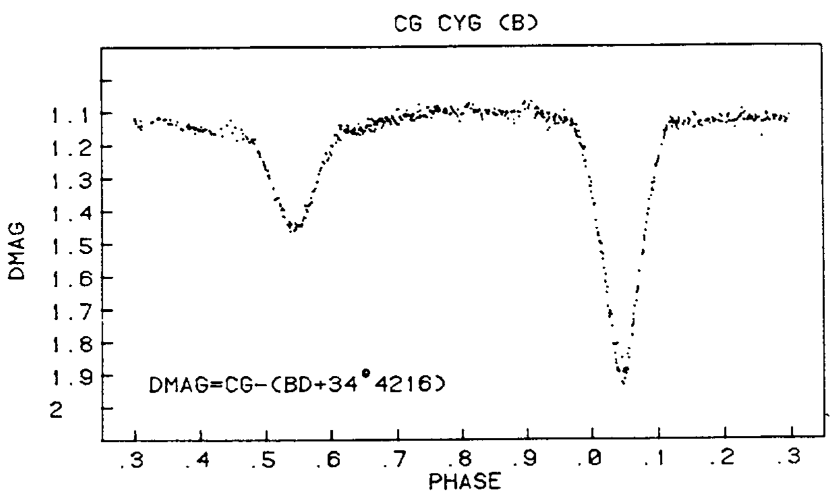

Figure 1

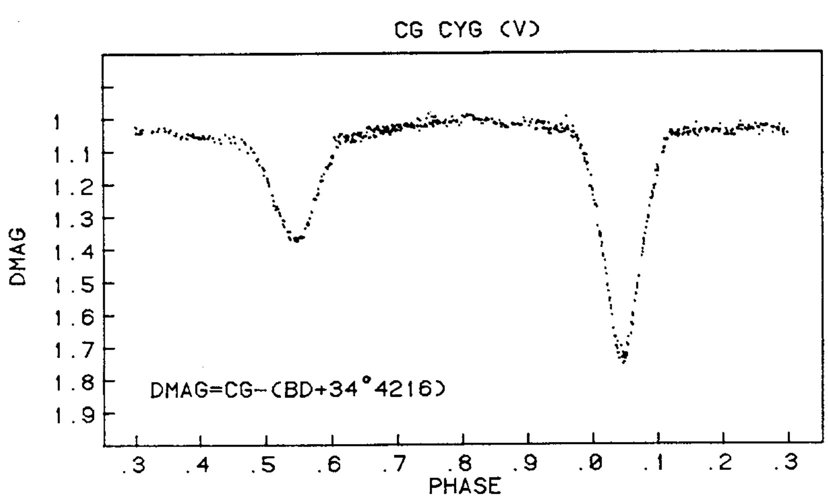

Figure 2

TABLE II

Type of minima	V COLOUR Heliocentric Jul. Day	(O-C) phase	B COLOUR Heliocentric Jul. Day	(O-C) phase
Primary	2448455.5163 ±0.0001	0.045	2448455.5163 ±0.0001	0.046
Primary	2448457.4097 ±0.0001	0.045	2448457.4099 ±0.0001	0.046
Secondary	2448458.3563 ±0.0003	0.545	2448458.3560 ±0.0003	0.545
Secondary	2448463.4048 ±0.0002	0.545	2448463.4048 ±0.0003	0.545
Primary	2448464.3527 ±0.0002	0.046	2448464.3528 ±0.0002	0.046

TABLE III

Differences between Primary and Secondary minima for CG Cygni in B and V colours

DATE	δB(mag)	δV(mag)
1991	0.46	0.37
1990	0.48	0.37
1989	0.45	0.39
1988	0.34	0.30
1987	0.41	0.30

From Figures 1 and 2 it can be seen that there are irregularities outside the eclipse already reported previously by Milone et al. (1979), Dapergolas et al. (1989b), Beckert et al. (1989), Dapergolas et al. (1991), and Zeilik et al. (1991).

The observed differences between the primary and secondary minima for the period 1987 - 1991 are listed in Table III (Dapergolas et al., 1988, 1989a, 1989b, 1991).

From the values of Table III it can be seen that there is a variation in the difference of both minima depths and for both colours probably due to the photospheric activity of the system.

From the times of minima found here and those published by Milone et al. (1979) and Dapergolas et al. (1989a, 1989b, 1991) the O-C residuals show large variations which might be due to the continuous period variations of the system.

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DISCOVERY OF 5.66 DAY PERIODICITY OF HBC 379 = NTTS 041636+2743 = TAP 29 = LkCa 7

While T Tauri stars (TTS) are noted for their irregular variability on many time-scales, there are some early detections of quasi-periodicities on time-scales of a few days due to the rotational modulation. A likely explanation of the observed rotational modulation is the presence of dark (or hot) spots.

To search for the strict periodicities, photoelectric UBVR-photometry of about 70 TTS was made on Mt. Maidanak in 1986-1992. The results were published by Berdnikov et al. (1991), Grankin et al. (1991), and Shevchenko et al. (1991).

Observations of a number of new objects, so called "naked" TTS (Walter et al., 1988) were began by the author in 1990. In this paper we present the most important results of the search for periodicity of the object HBC 379 = NTTS 041636+2743 = TAP 29 = LkCa 7.

The star HBC 379 is a K7-M0 V pre-main-sequence star discovered in the CaII H and K emission-line survey of Herbig et al. (1986). It is a variable ($12\overset{m}{.}3 < V < 12\overset{m}{.}6$) with weak H_α emission (E.W. = 4Å), strong lithium absorption (E.W. = 0.5Å), low obscuration (E_{B-V} = 0.2), slow surface rotation (V$\cdot$sini < 11 km/s), no infrared excess, bolometric luminosity of $\sim 1L_\odot$, and ra-radial velocity consistent with membership in Tau dark cloud (Herbig et al., 1986, Hartmann et al., 1987). HBC 379 is also an x-ray source (Feigelson et al., 1987).

Our observations of HBC 379 were made in 1990-1991 on Mt. Maidanak using the 0.5m reflector with UBVR-pulse counting photometer. The limits of the light variations, average colours and number of observations are listed in Table I.

To search for a period in the light variability, the observations were analysed by the method of digital spectral analysis (Grankin et al., 1991). The analysis yields a period of 5.66$\pm$0.005 days. Phase diagrams for light-curve in the UBVR filters for a period of 5.66 days are displayed in Figure 1.

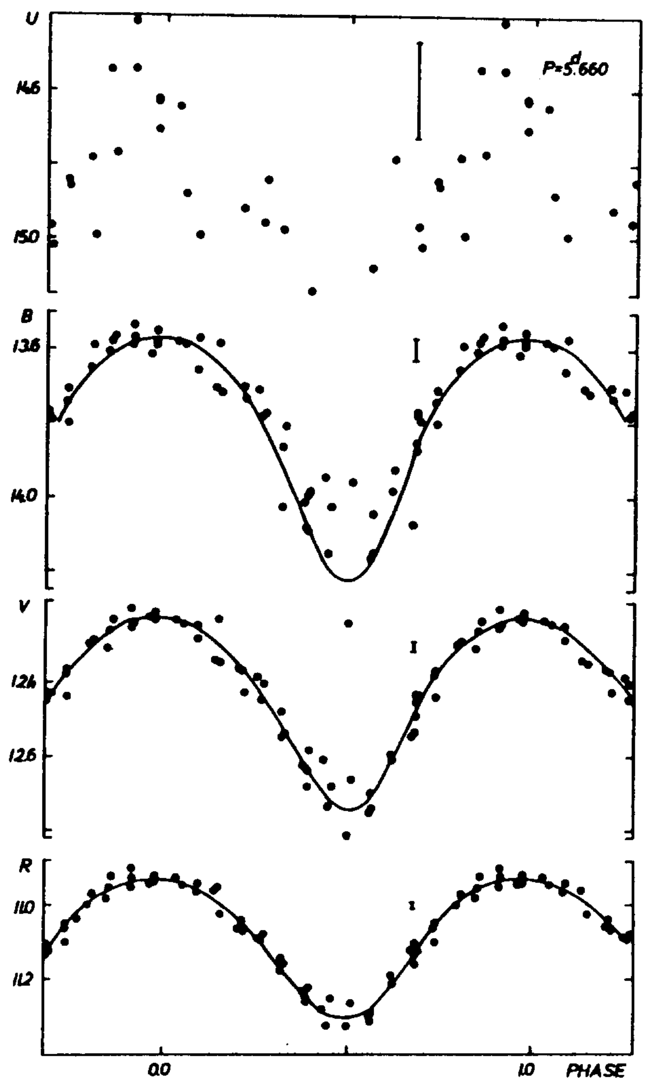

Figure 1. Phase diagram of HBC 379 in the UBVR filters (P=5.66 days). The observed data points are shown by filled dots and the solid line is a synthetic light-curve calculated with parameters given in Table II. Error bars show ± 1 standard deviation.

Table I. Photometric data of HBC 379

J.D. 2440000+	n	Vmax	Vmin	<V>	<U-B>	<B-V>	<V-R>
8182 - 8230	18	12.21	12.68	12.441	1.174	1.348	1.338
8503 - 8572	36	12.20	12.81	12.443	1.063	1.390	1.350

Table II. Parameters and results of HBC 379 spot model

Fixed parameters	
Rotation period:	5.66 days
Photospheric temperature:	3800 K
Limb Darkening Coefficient in B:	1.0
in V:	0.89
in R:	0.74
Results	
Spot temperature:	3400 $\pm$ 25 K
Rotation axis inclination:	$36^\circ \pm 1^\circ$
Spot polar distance:	$20^\circ \pm 1^\circ$
Spot radius (in degrees):	$65^\circ \pm 2^\circ$

The amplitudes of the periodic process change considerably for each filter ($0^m.37$ R, $0^m.52$ V, $0^m.65$ B). We studied the light variations appearing as a consequence of a dark spot on the photosphere of the star. The shape of the light-curve may depend on the position of the spot on the stellar surface, the orientation of the rotational axis relative to the observer, the size of the spot, and the temperature difference between the spot and the photosphere.

The range of spot properties for which we find acceptable fits to the observed light-curves and the actual parameters used for computing the synthetic light-curves is given in Table II. It should be noted that the spot size has a lower limit due to the large changes of the colour indices ($>$0.15 mag). These changes are possible if the radius of the spot exceeds 50 degrees.

Persistency of a very large cold spot or a compact cluster of spots (the fractional stellar surface covered by the spot ~30%) is difficult to explain in the frame of the hypothesis of solar-type magnetic activity. We mean the localization of the spot or the cluster of spots on one hemisphere of the stellar surface.

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CH Cygni - recent spectral variations

CH Cyg is a symbiotic star often observed and investigated in a wide spectral range during the last 30 years (Kenyon 1986, Selvelli 1988). It is a long-period (~5700^d) eclipsing binary (Mikolajewski, Tomov and Mikolajewska 1987) consisting of a late red giant and a white dwarf. A few high-activity periods of the star have been observed since 1963. An intensive hot continuum, strong permitted and forbidden emissions and absorption lines of single-ionized metals are typical during these active phases. In the quiet periods the spectrum is normally dominated by the M-giant features.

Until recently it was supposed that the observed active phases of the star are three (see for example Selvelli 1988). Mikolajewski, Mikolajewska and Khudyakova (1990), analyzing the long-term light curve of CH Cyg during 1885-1988 have not found evidence of the star's activity before 1963. They assumed that at least four active phases have been observed afterwards.

The last outburst has finished in 1987 and we expected a quiet period of a few years. But CH Cyg confirmed its unpredictable behavior very soon. In this short note the most prominent spectral changes during the last few years are described.

The low-resolution (~2A) spectra were obtained with the Canadian Copernicus Spectrograph (3400-5200AA) mounted at the Cassegrain focus of the 90cm telescope of the Torun Observatory. They have been reduced to the Hayes and Latham (1975) flux scale using standard methods. The high-resolution (~0.35A) spectra were obtained using the Coude-spectrograph (3600-4900AA) of the 2m telescope at National Astronomical Observatory Rozhen.

The M-giant spectrum is completely dominant in the optical during 1988 only. Since the summer of 1989, first indications of a new activity such as increasing of the hot continuum, appearance in the spectrum of noticeable emission lines of HI, FeII, [FeII], weak emissions of [NeIII] 3869A and [SII] 4068A as well as rapid brightness variations have been observed (Tomov et al. 1989, Mikolajewski et al. 1990). Later some other emission lines became observable. The predominant part of these features, varying in a different way, were present in the spectrum from the middle of 1989 until the last observations during March 1992.

The considerable changes of the hot continuum intensity are illustrated in Fig.1.

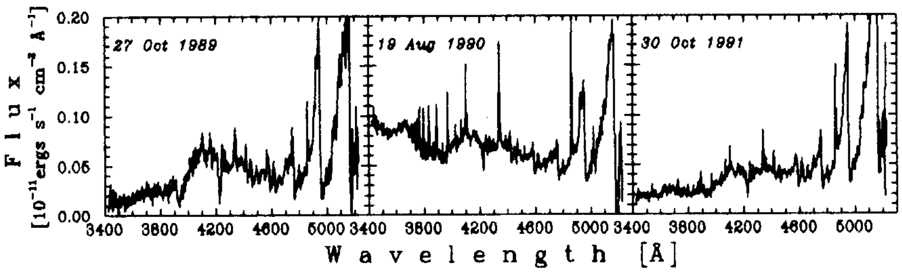

Figure 1

The lines and TiO-bands of the M-giant were dominant in the absorption spectrum. Varying in intensity and shape, the Balmer lines are present in the most spectra as single- component emissions. During 1989 they were visible up to H_{10-12} and in the next year they gradually became visible up to H_{20-22}. In the period June-August 1991 all Balmer lines showed quite different profiles. They were wider and with two emission peaks separated by a relatively weak absorption component (Fig.2). These two-component profiles of the higher Balmer series members appeared for the first time since 1986. The only exception is H_α which shows weak double-peaked emission profile even during the period 1987-1989 (Bopp

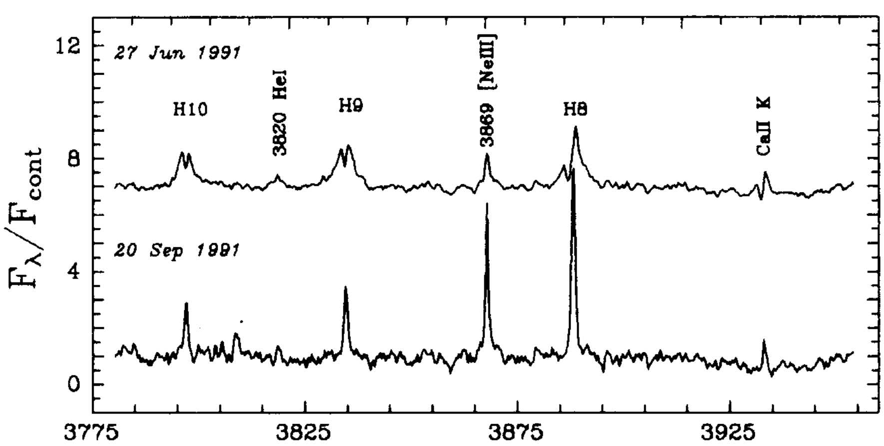

Figure 2

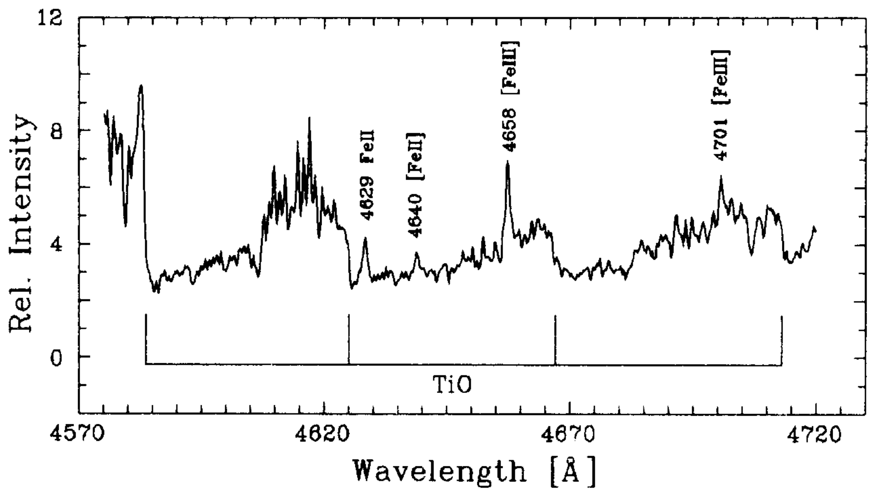

Figure 3

1990; Bode et al. 1991; Tomov et al. 1992, in preparation). A new significant change of the Balmer lines occurred in September 1991 when the emissions were one-component again. They were considerably stronger in comparison with June 1991 and their shapes were the sharpest in the whole period July 1989 - March 1992 (Fig.2).

Now, as it is typical for the high-activity phases of CH Cyg, the permitted and forbidden lines of FeII are the most numerous in the spectrum. Occasionally, intensity variations of these lines with characteristic times of a few days are noticeable. A similar behavior shows the [SII] 4068A emission line.

It should be mentioned that the emission lines of [FeIII] 4658A and 4701A appear in the spectrum of CH Cyg for the first time. As it is shown in Fig.3 they are very prominent in the spectrum on September 20, 1991.

A few emission lines of HeI such as 4713A, 4471A, 4026A and 3820A appeared in the spectrum in the beginning of 1990. They are variable in intensity too, but they remain single-component all the time in contrast to the Balmer lines.

In the spectrum obtained on July 11, 1989, a weak and sharp emission component located near the center of the wide and intensive absorption of CaIIK belonging to the M-giant, was visible. Its intensity remarkably increased in May 1990. During the next two months this single-component emission line of CaIIK gradually transformed into a profile with two emission peaks separated by an absorption component. This shape is typical for CaIIK in our spectra with two exceptions: on September 20 and 27, 1991 (Fig.2).

Besides the nebular emission [NeIII] 3869A, the high-resolution spectra includes the line [OIII] 4363A as well. All the time after July 1989 [NeIII] 3869A existed in the spectrum of CH Cyg certainly. Sometimes this line was rather weak but at times it was one of the most intensive emissions in the spectrum (Fig.2). The nebular emission [OIII] 4363A can be clearly identified after the middle of June 1990. Changing its intensity it reached the maximum in September 1991.

Of course, the spectral variations of CH Cyg described here demonstrate only one side of the activity during the last three years. In addition, considerable brightness variations of the system, as well as the typical for the active stages flickering have been observed (Tomov et al. 1992, in preparation).

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1991 ECLIPSE TIMINGS FOR 44 i BOOTIS AND UP-TO-DATE EPHEMERIS

The eclipsing binary 44 i Boo was observed photoelectrically by our group in the summer of 1991. We wanted to see whether the recent period increase suggested by Oprescu et al. (1991) would be confirmed.

Our observations were made at Braeside Observatory near Flagstaff, Arizona using the computer-controlled 16-inch Cassegrain telescope and photoelectric equipment of the second author. The last three authors are high school students who did much of the observing and initial analysis for this project under the guidance of the first author as part of an N.S.F. summer program conducted by Northern Arizona University.

Times of both primary and secondary minima derived from our photometry are presented in Table 1, where cycle numbers and O-C residuals are computed with the ephemeris

$$C_1 = 2443604.5880 + 0^d\!.26781753\ E \qquad (1)$$

given by Oprescu et al. (1991) to describe eclipse times after an earlier period increase suggested by Oprescu et al. (1989). It will be seen that primary eclipse was observed on two of the nights and secondary on the other.

Figure 1 is an O-C curve based on the ephemeris in equation (1). Plotted are all of the times listed by Oprescu et al. (1991) with $E > 0$, along with our new times from Table 1. We were forced to recompute O-C values from the Julian dates given because of numerous errors and omissions. The largest error was at JD 2445473.8187, given as O-C = $+0^d\!.0085$ when it should have been O-C = $-0^d\!.0018$. The most serious omission was the five times of Willmitch and Hall (1989). Coincidently, this was the reference which the bibliography of Oprescu et al. (1991) mistakenly attributes to Willmitch and Douglas.

Oprescu et al. (1991) claimed that the period increased "after 1987" but did not specify the epoch more precisely than that. They estimated the size of the increase to be $\Delta P = 1^s\!.02666 \times 10^{-6}$, although surely 5 decimal places of accuracy are not warranted. For the new ephemeris "after 1987" they proposed

$$C_2 = 2443604.5880 + 0^d\!.26781856\ E\ , \qquad (2)$$

although the initial epoch in this ephemeris must be grossly in error, as one can see by inspection of their second figure.

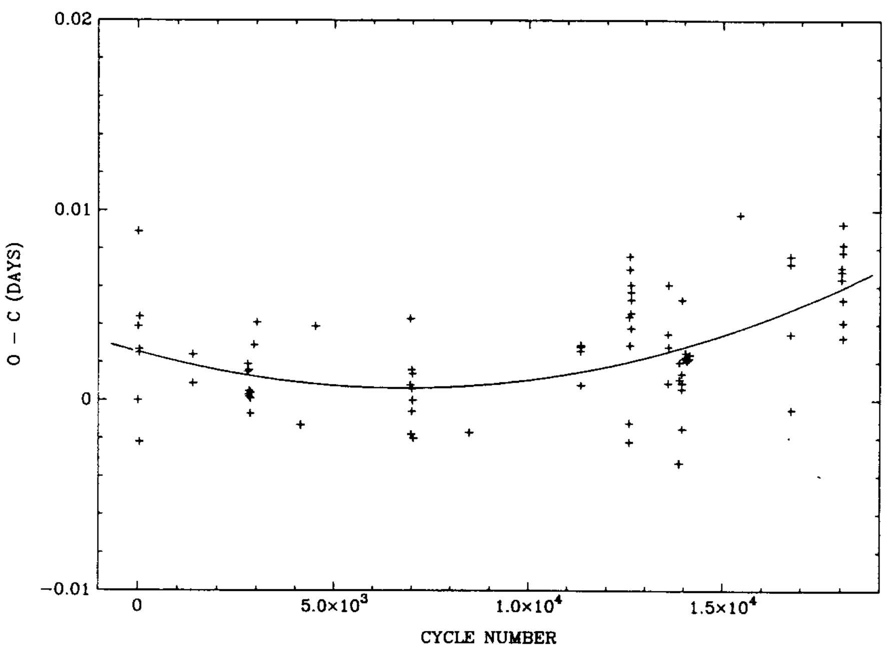

Figure 1. O-C curve for 44 i Boo, with residuals based on the ephemeris in equation (1). Points are from the Julian dates given by Oprescu et al. (1991) with E > 0, and from our Table 1. The solid curve represents the quadratic ephemeris in equation (3). Note the increasing period.

Table 1. New times of minimum of 44 i Boo.

JD(hel.) 2440000+	E	O-C (days)	Filter
8429.8634	18017	+0.0070	V
8429.8629	18017	+0.0064	B
8429.8632	18017	+0.0068	U
8437.7649	18046.5	+0.0078	V
8437.7663	18046.5	+0.0093	B
8437.7623	18046.5	+0.0053	U
8439.7698	18054	+0.0041	V
8439.7739	18054	+0.0082	B
8439.7690	18054	+0.0033	U

We found that points in Figure 1 are fit better with a quadratic ephemeris than with two straight-line segments, although both fitting techniques indicate a period increase. Our quadratic ephemeris, determined by least squares with all points given equal weight, is

$$C_3 = 2443604.844 + 0\overset{d}{.}26781696\,E + 0\overset{d}{.}42 \times 10^{-10}\,E^2 ,$$
$$\pm.077 \quad \pm.00000020 \quad \pm.11$$

where the algebraic sign of the quadratic term does indicate an increasing period. In this fit two points rejected by the 3-sigma test were not included in the fit and are not plotted in Figure 1.

Our recent timings do confirm the period increase suggested by Oprescu et al. (1991), in that they fall in line with the solid curve in Figure 1 which represents the quadratic ephemeris in equation (3). Moreover, our fit itself is consistent with the value of the current period suggested by Oprescu et al. (1991). One can write

$$P = dC/dE , \qquad (4)$$

where C is the computed eclipse time given by any ephemeris and P is the instantaneous period at any epoch. For the ephemeris in equation (3) one gets

$$P = 0\overset{d}{.}26781696 + 0\overset{d}{.}84 \times 10^{-10}\,E , \qquad (5)$$

which, at E = 18054, yields P = $0\overset{d}{.}26781848 \pm 0\overset{d}{.}00000045$. This is perfectly consistent with the value $0\overset{d}{.}26781856$ suggested (with no uncertainty indicated) by Oprescu et al. (1991).

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A NEW VARIABLE IN AQUARIUS

While conducting an observing program directed toward the study and determination of the synodic rotational periods of minor planets, it was noticed that one of the comparison stars varies about 0.3 magnitudes (V) almost in two hours. Since this star is not listed in neither the GCVS nor the NSV catalogues, I conclude that its variability has not been previously reported.

Additional differential BV photometry was obtained using a cooled photon-counting photometer equipped with an RCA 31034A photomultiplier tube attached to the 0.76m reflector at the Estacion de Altura "Dr. Carlos U. Cesco" of Felix Aguilar Observatory on the nights of September 8, 1991 and November 12, 1991.

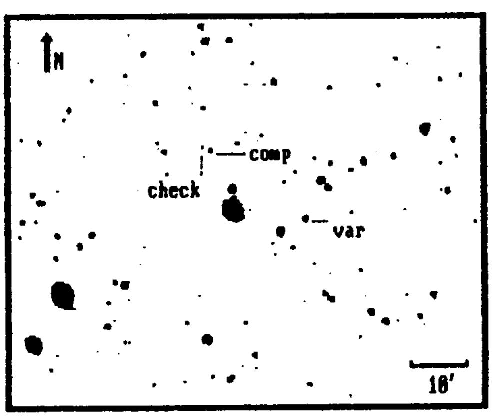

Figure 1

Table I

GSC	R.A. (1950)	DEC	
5198.00659	$21^h18^m48^s.735$	$-3^\circ22'22''.663$	variable
5199.00616	21 20 7.775	-3 8 49.470	comparison
5199.00693	21 20 15.014	-3 8 17.191	check star

Table II

JD	V	B-V
8507.5854	$10^{m}.074$	$+0^{m}.658$
8507.6005	9.925	0.625
8507.6151	9.843	0.632
8507.6359	9.790	0.626
8507.6504	9.952	0.632
8572.5764	9.835	0.734
8572.5849	9.816	0.745
8572.5924	9.777	0.755
8572.6035	9.748	0.754
8572.6096	9.713	0.779
8572.6175	9.709	0.766

Another comparison star selected for the additional photometry (V = 9.953, B-V = 1.518) was standardized using standard stars of the Selected Area 113 (Landolt 1973, 1983). The standard error about the mean in V and B-V for the comparison star was 0.012 and 0.020 magnitude respectively. Table I gives the astrographic information (equinox 1950) of these stars which was obtained from the Hubble Space Telescope Guide Star Catalogue (CD ROM Version 1) using the Pickles Software Package (v3.058) (McCartney et al., 1989) and Figure 1 is the finder chart for the new variable. Table II shows the V and B-V values obtained.

This star seems to be variable in both V and B-V, and showed a tendency towards reddening in the November 12 observing night. A period search seems to be useless at this stage, so nothing can be said about the type of variability.

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Updated ephemerides for the cataclysmic variable EX Hydrae

Cyclical variations in the orbital periods of close binary systems may be caused by solar-type magnetic cycles of the component stars (Warner 1988) although the mechanism is still under discussion (see Applegate 1992 and references therein). The cataclysmic variable EX Hya shows orbital period fluctuations consistent with a ~ 20 year cyclical variation (Jablonski & Busko 1985; Bond & Freeth 1988), however since observations cover only ~ 1 of these cycles continued monitoring is required. We observed EX Hya on several nights over the interval 1991 Jan 10–22, five years after the last published data. We used the 0.75-m telescope of the South African Astronomical Observatory, making 2-s integrations with the UCT photometer and an unfiltered RCA Ga As tube.

The 98-min orbital period in EX Hya is manifest as sharp, shallow eclipses which make excellent fiducial marks. We timed 13 eclipses, measuring their midpoints by fitting with a Gaussian profile (Table 1). To investigate the long term behaviour we have calculated the residuals about the linear ephemeris of Mumford (1967), corrected to barycentric dynamical time:

$$TDB_{\text{eclipse}} = 2437699.94179 + 0.068233846\, E$$

These residuals are plotted in Fig. 1 along with previously published data (from Bond & Freeth 1988 and references therein). The new timings are consistent with the suggested cyclical variation; a sinusoidal fit gives:

$$\begin{array}{l} O - C = -0.00027 + 0.00028 \sin[360^{\circ}(E/93500) + 7^{\circ}] \\ \qquad\qquad\quad \pm 3 \qquad\quad \pm 4 \qquad\qquad\qquad \pm 6500 \pm 24 \end{array}$$

where the period of 93500 cycles corresponds to 17.5 ± 1.2 years.

TABLE 1: Timings (TDB − 2448200)

Eclipses	72.50212	76.59601	Spin	72.5123	75.5416
66.56632	72.57081	78.57531	67.5824	72.5635	75.5894
67.58930	73.59361		68.5629	72.6085	76.5730
68.54457	74.54889		68.6100	73.5861	76.6081
68.61324	74.61851		69.5430	74.5687	78.5623
69.56834	75.57312		69.5807	74.6096	78.6098

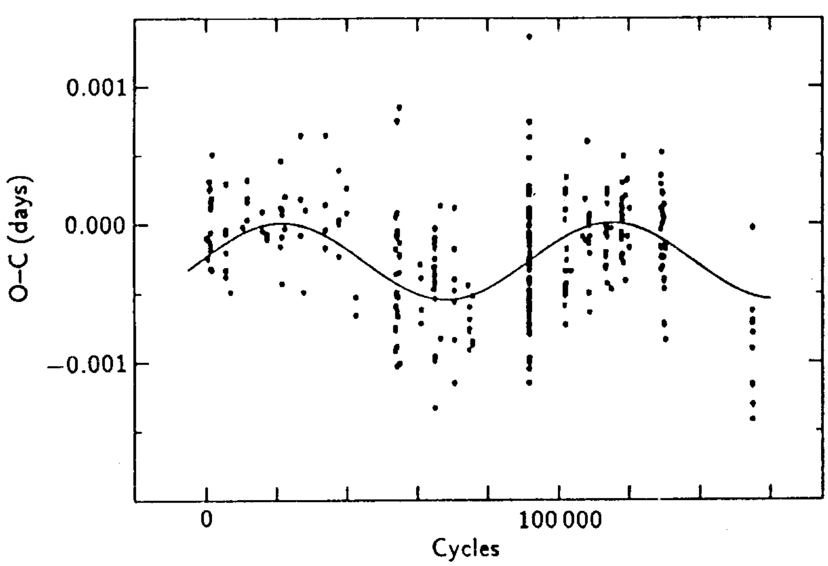

FIGURE 1: Residuals of eclipse timings

EX Hya contains a magnetic white dwarf which produces a prominent sinusoidal photometric modulation at the 67-min rotation period. This period is decreasing secularly, presumably due to the accretion of angular momentum. We have measured the times of spin maxima in the light curves by eye, for consistency with previous work (Table 1). The residuals against the linear ephemeris of Vogt *et al.* (1980) are shown in Fig. 2 along with the compilation of previous data. A quadratic fit to the data gives the ephemeris:

$$TDB_{67-\max} = 2437699.8914(5) + 0.046546504(9)E - 7.9(4) \times 10^{-13}E^2$$

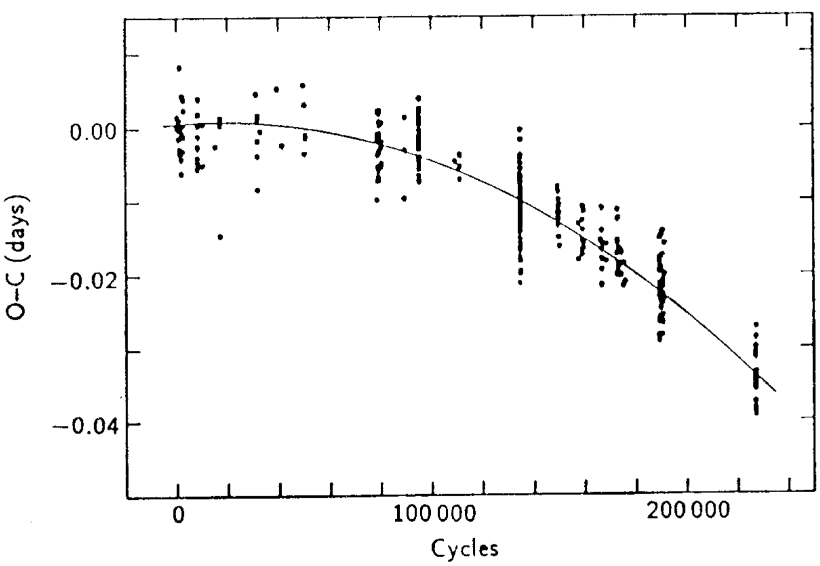

FIGURE 2: Residuals of spin maximum timings

We thank the SAAO for the allocation of telescope time.

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HV And: a peculiar non– or weakly–magnetic CV

Earlier reports on this blue variable were given in IBVS by Meinunger (#1795), Andronov & Banny (#2763) and Andronov & Meinunger (#3015). Based on plate photometry and single spectra obtained at Tautenburg observatory and the SAO Selenchukskaja they suggested that HV And belongs to the strongly magnetic cataclysmic variables, the so called AM Herculis stars or polars.

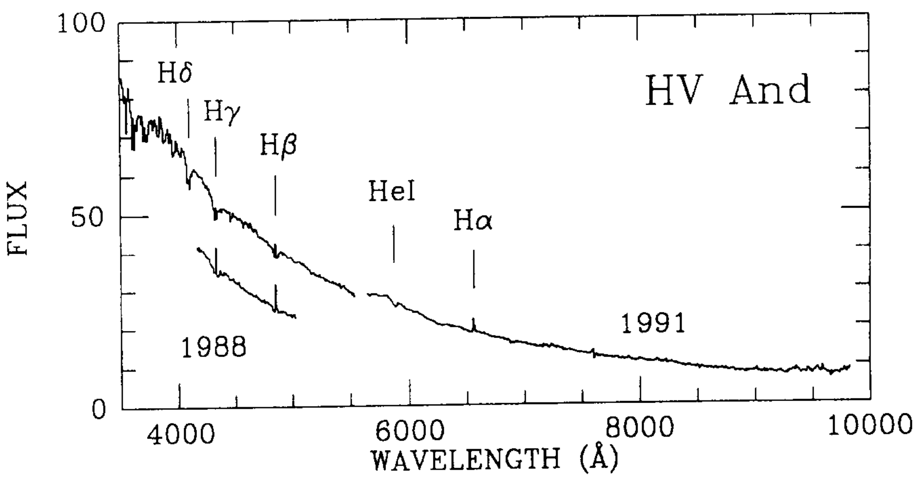
We obtained a short ($1^h.4$) sequence of circular and linear polarimetric observations on June 17, 1988, using the 2.2m telescope situated atop Calar Alto. With the 3.5m telescope at the same observatory we obtained single high–resolution (60Å/mm, $\lambda\lambda 4150 - 5050$ Å, T_{int} = 30 min, Nov. 1988) and low-resolution spectra (144Å/mm, $\lambda\lambda 3500 - 5500$ Å, 160Å/mm, $\lambda\lambda 5600 - 9800$ Å, T_{int} = 15 min, July 1991). The original spectra are shown in Figure 1. In Figure 2 we show the spectra normalised to a smooth continuum on an expanded scale.

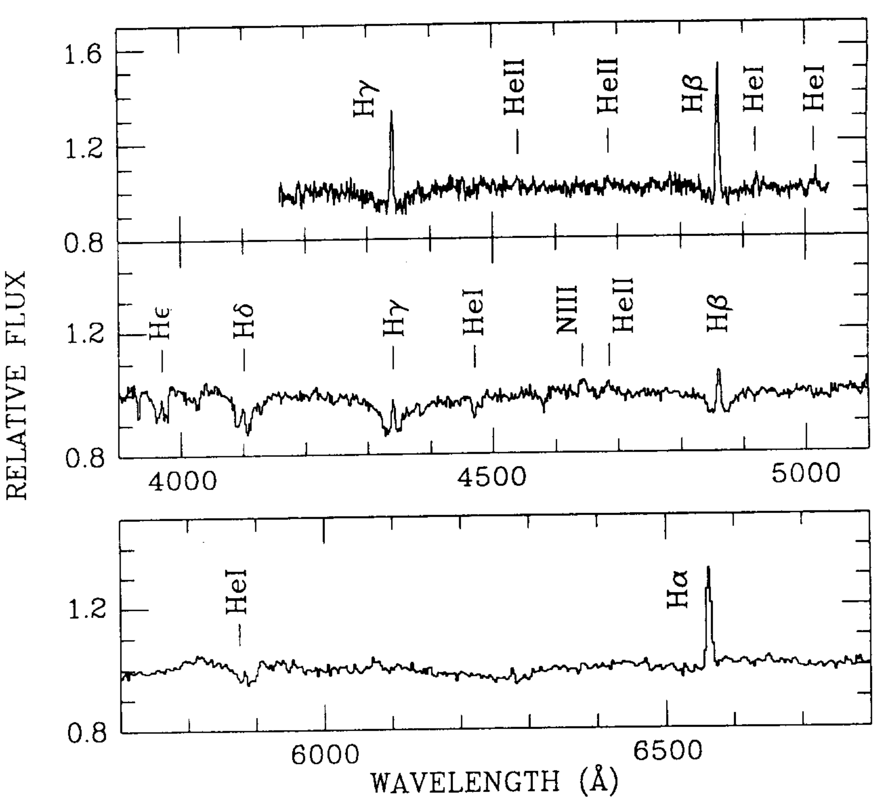
The 1991 low–resolution spectrum: HV And displayed the spectrum of a typical disk–CV. The continuum slope follows a power law, $F_\lambda \propto \lambda^{-\alpha}, \alpha = 2.6$, with broad Balmer absorption lines and narrow emission lines superimposed. The higher excited lines are stronger in absorption and weaker in emission. Due to the rather low resolution ($\sim 6 - 7$ Å in the blue, ~ 8 Å in the red) the narrow emission lines are not or only barely resolved. Further lines which are clearly recognizable are HeI $\lambda\lambda$4471, 5876 (absorption and emission) as well as CIII/NIII 4643 and HeII 4686 in emission. We did not find any features of the secondary star. Rough Johnson brightnesses are $B \simeq 15^m.3$ and $V = 15^m.2$.

The emission lines of H and He display peculiar radial velocity shifts. While the H–Balmer lines appear slightly blueshifted, $v \simeq -10 \ldots -160$ km s^{-1}, the HeI lines are clearly redshifted with v(HeI4471) $\simeq +155$ km s^{-1}, and v(HeI5876) $\simeq +420$ km s^{-1}. On the other hand, the weak emission of HeII 4686 appears slightly blueshifted, $v \simeq -110$ km s^{-1}. The complete information about the individual lines may be found in the Table.

The 1988 high–resolution spectrum: Compared with the 1991 observation the continuum brightness was reduced by ~ 0.5 mag while its slope remained approximately unchanged. The decrease of the continuum flux is accompanied by an increase of the Balmer emission line flux and a weakening of the corresponding broad absorption (equivalent widths of Balmer emission lines are given in the Table). Our spectral resolution was sufficient to resolve the emission cores. The FWHM of these lines is ~ 340 km s^{-1}. The intrinsic width of the lines might be smaller, considering the possibility of radial velocity variations during the (long) integration time of 30 min. Weak emission of HeI 4921, 5015 and HeII 4686 (4541?) is present, too. Again, the narrow emission of H and HeII appears blueshifted and that of HeI redshifted. The radial velocities differ from those obtained in 1991.

Polarimetric observations: The Calar Alto polarimeter allows circular and linear polarisation to be determined simultaneously, the latter with reduced efficiency. Results of our polarimetric observations are shown in Fig. 3. During the $1^h.4$ interval of observation HV And varied photometrically by about $\sim 20\%$. A possible polarimetric event with maximum circular polarisation of $P_{\rm CP} \simeq (3 \pm 1)\,\%$ and linear polarisation $P_{\rm LP} \simeq (4 \pm 1.5)\,\%$ was observed around HJD 244 7329.59. This event corresponds to the clustering of the polarisation angle ψ at $160 - 170°$ at that time, whereas ψ displays a large scatter otherwise.


HV And
FLUX
100
50
0
4000
6000
8000
10000
WAVELENGTH (Å)
Hδ
Hγ
Hβ
HeI
Hα
1988
1991


RELATIVE FLUX
1.6
1.2
0.8
Hγ
HeII
HeII
Hβ
HeI
HeI
Hϵ
Hδ
Hγ
HeI
NIII
HeII
Hβ
4000
4500
5000
HeI
Hα
6000
6500
WAVELENGTH (Å)

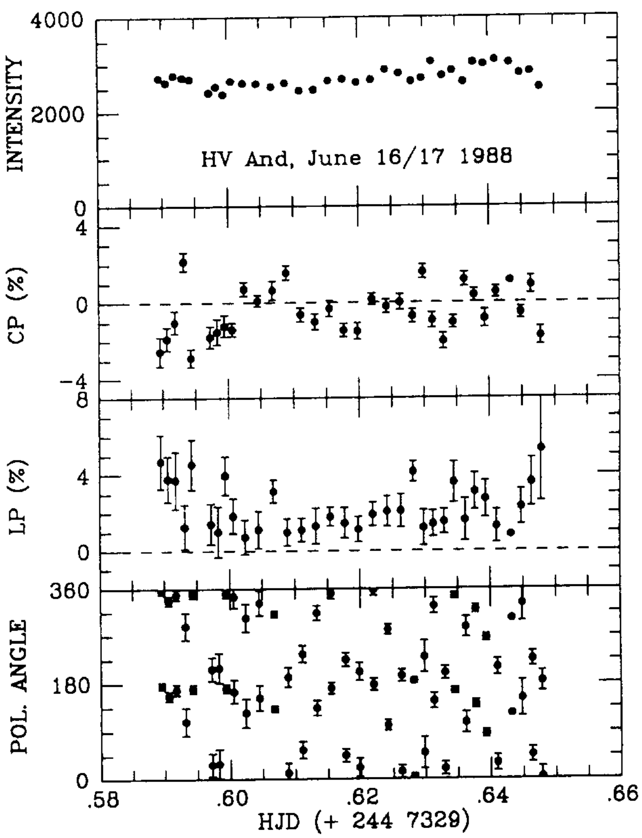


Fig. 3: Polarimetric observations of HV And. Shown are from top to bottom the white–light intensity, the degree of circular and linear polarisation and the linear polarisation position angle, respectively.

Fig. 1 ***(preceding page, top)*****: Flux– and wavelength– calibrated spectra of HV And obtained on Nov. 18, 1988, and July 11, 1991. Flux units are 10^{-16} erg cm^{-2} s^{-1} Å^{-1}.**

Fig. 2 ***(preceding page, bottom)*****: The same spectra as in Fig. 1 are shown on an expanded wavelength scale after normalisation to continuum intensity 1. The 1988 spectrum is shown in the top panel.**

Table I

Line	Absorption V_{rad} (km s^{-1})	FWHM (km s^{-1})	Emission V_{rad} (km s^{-1})	FWHM (km s^{-1})	Equi. W. (Å)	Line flux (10^{-16} erg cm^{-2} s^{-1})
1991						
Hα	−230:	1200:	−10	< 380	3.1	58
Hβ	−80	2000	−84	∼ 490	1.5	62
Hγ	−130	2000	−82	∼ 500	1.4	76
Hδ	−107:	1400:	−157	≲ 500	0.7	45
HeI 4471	—	—	+155	"	0.6	30
HeI 5876	—	—	+380	"	0.3	10
HeII 4686	—	—	−110	"	—	—
1988						
Hβ	−13:	3400:	−24.8	350	3.3	85
Hγ	−210:	4500:	−28.3	330	2.1	76
HeI 4921	+46:	1800:	+65	280	0.4	10
HeII 4686	—	—	−44:	290:	—	—

Discussion: HV And is clearly not a polar. It contains an (optically thick) disk which was seen at different brightness in 1988 and 1991. Its spectral appearance resembles those of a high–mass–transfer novalike CV, a dwarf nova in outburst, a VY Scl star or even an intermediate polar (IP). If the first case, HV And must belong to the long–period CVs and the suggested period of ∼ 80 min (Andronov & Banny 1985) cannot be the orbital period. No dwarf–nova outburst of HV And has been reported so far. The possible detection of polarised light would be, if confirmed, strongly suggestive of the latter possibility (IP). The emission lines of confirmed intermediate polars, on the other hand, are much broader than those of HV And and may have complex structure. The case of HV And appears to be similar to that of TT Ari which was also classified as either novalike, subtype VY Scl, or as an intermediate polar. Its high–state spectrum resembles that of HV And in its 1991 high state. A detailed (high–speed) photometric investigation of HV And is necessary in order to derive the orbital and possible further photometric periods and to ascertain its subtype.

HV And seems to be a unique object with respect to the peculiar radial velocities found in H and HeII on one hand and in HeI on the other hand. It is clear that the lines of the different species origin at different places in the system. While the Balmer lines may be probably located in the disk the origin of the HeI lines remains unclear. Since they always appear redshifted they cannot be formed in a wind emanating the accretion disk.

Deeper insight into the physics of that puzzling system may be derived from a detailed radial velocity study which is strongly encouraged.

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PHOTOGRAPHIC OBSERVATIONS OF FIVE DHK VARIABLES

Kaiser (1991) reported the discovery of four new variable stars and confirmed the variability of four stars previously listed in the New Catalogue of Suspected Variable Stars (Kholopov et al. 1982). I have examined these stars on the Harvard patrol plates, and this report presents results for the five variables in Lyra, Sagitta, and Cygnus. Equatorial coordinates, and a finding chart for DHK 21, can be found in Kaiser (1991).

For speed and convenience, estimates on the Harvard plates were made using step values for the comparison stars. Comparison star magnitudes were determined later, using blue-sensitive films exposed with the 25-cm astrograph (f/6.3 Cooke triplet) of Indiana University's Goethe Link Observatory. Magnitudes were estimated with an image scale calibrated to nearby photoelectric B sequences from the Guide Star Photometric Catalogue I (Lasker, Sturch, et al. 1988).

DHK 19 - BD +40°3449, HD 172740, SAO 47682, IRC +40324 (LYR)

Spectral type M. This star was estimated on 208 plates of the Damon series for the interval 1973-1989. The variations are semi-regular with an extreme range of 9.2-10.5 ptg. Discrete Fourier Transform analysis found a weak frequency peak representing a period of 68.3 days, which supersedes the initial estimate of 60: days in the discovery report. A 2000-day sample of the light curve is shown in Figure 1. The field was photographed only once or

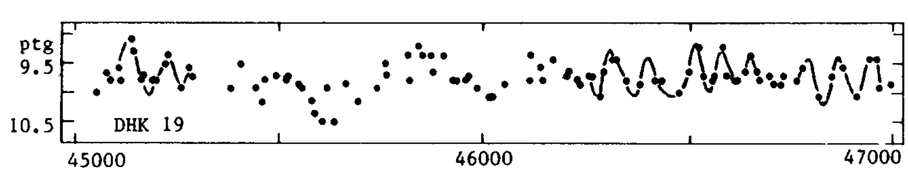

Figure 1. JD 2400000+

twice per month. With only 2-4 plates per 68-day cycle, the semi-regular variations are not obvious, so several cycles have been marked on the light curve with a freehand line. As often occurs with SR-type variables, the amplitude and the mean magnitude vary with time and the characteristic 68-day cycles occasionally disappear or undergo a phase shift.

* * * * *

The remaining four variables were observed on the same wide-angle Damon patrol plates with field center in Cygnus. Due to limited time, these variables were estimated only on the 42 plates exposed during the 2000-day interval JD 2441900-43900.

DHK 20 - NSV 12930, BD +16°4199, HD 192446, IRC +20460 (SGE)

Spectral type S. Variability was first noted by Weber (1958). The variations show an extreme range of 9.8-11.2 ptg. DFT analysis of all the observations found no definite periodicity in trials of periods from 10-950 days. However, while the earlier portion of the light curve (Figure 2) shows rather confused, almost irregular variations, the light curve from JD 2443300-900 shows shorter, more regular cycles. DFT analysis of this very small data set found a strong frequency peak for the period 102.4 days. This variable is probably SR type but, like DHK 19, the characteristic cycles are often lost or disturbed.

DHK 21 - BD +46°2892 (CYG)

Spectral type M5. Variability is semi-regular with an extreme range of 11.4-12.3 ptg (Figure 2). DFT analysis found a period of 466.4 days, which supersedes the value of 400: days in the discovery report. Identification of this variable with BD +46°2892 was made by Bidelman (1992), based on the match between the BD atlas and the finding chart in the discovery report. A SIMBAD database search for stars at the position published by Kaiser found AG +46°1602. The AG Catalogue (AGK2, 1952) identifies this star as BD +46°2892, so Bidelman appears to be correct. A slightly improved position from the AGK2 is 20h 14m 16s, +46° 45.2′ (1950).

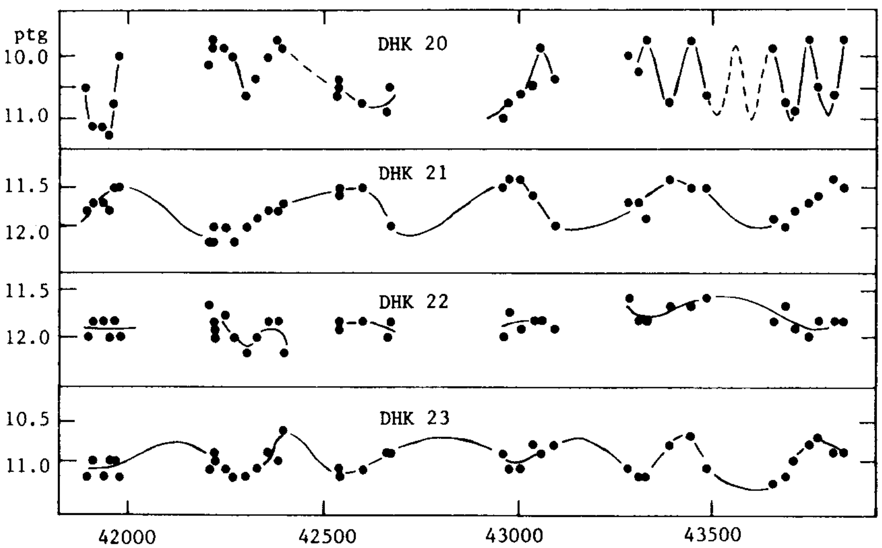

Figure 2. JD 2400000+

DHK 22 - BD +31°4024, HD 332077, SAO 69757 (CYG)

Spectral type M9 or (probably) S. The observations show an extreme range of 11.6-12.2 ptg (Figure 2). DFT analysis found no definite periodicity in trials of periods from 10-950 days, so classification as type Lb, as suggested in the discovery report, is consistent with the observations.

DHK 23 - NSV 13178, BD +31°4152 (CYG)

Spectral type M1IIIe. This variable was first reported by Espin (1900). According to the NSV Catalogue, variability was confirmed by Sandig (1950), but Erleksova (1955) found that the star was constant. I found semi-regular variations with an extreme range of 10.7-11.2 ptg. DFT analysis indicates a period of 344.1 days, which supersedes the initial estimate of 340: days in the discovery report. Although the amplitude is only 0.5 magnitude, the semi-regular cycles of 280-400 days are readily apparent (Figure 2).

I wish to thank Dr. Martha Hazen for extensive use of the Harvard College Observatory plate collection, and the Astronomy Department of Indiana University for use of the Link Observatory facilities under the auspices of the Indiana Astronomical Society. Some of the information in this report was obtained from SIMBAD, database of the Strasbourg, France, Astronomical Data Center, for which I thank Joyce Rey-Watson of the Harvard-Smithsonian Center for Astrophysics and Elizabeth Waagen of the AAVSO staff. Daniel H. Kaiser provided software for data processing and period analysis, as well as notes on several of these variables communicated to him by Dr. William P. Bidelman.

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1991 PHOTOMETRY OF THE W UMa-TYPE BINARY CK Boo

Variability of the W UMa-type eclipsing binary CK Boo was discovered by Bond (1975). Aslan and Derman (1986) observed photoelectrically and gave the improved ephemeris,

$$\text{Min (I)} = \text{J.D.(hel.) } 2442897.3759 + 0^{\text{d}}.3551501 \times E$$

Demircan (1987) made BV photoelectric observations in April 1985, Pajdosz and Zola (1988) observed CK Boo in BV system in 1988.

We have put the system in our program in order to determine accurate ephemeris and to study its short time-scale light variation and the change in its orbital period. Photoelectric observations of CK Boo in UBV and Strömgren's Hβ(w), Hβ(n) systems were made on six nights between April and May in 1991 at Xinlong Station of Beijing Observatory. We used HD 128128 as the comparison star which was adopted by Bond (1975).

The light curves in U, B, V, Hβ(w) and Hβ(n) are shown in Figure 1 and 3 respectively. The B$-$V and U$-$B colour indices are plotted in Figure 2. The light minimum times are listed in Table II which includes other determinations known to us. The O$-$C residuals of the minimum time were calculated using the elements given by Aslan and Derman (1986). The O$-$C curve was made using the data of minima times from 1975 to 1991 (see Figure 4). It had been fitted well by a parabolic curve, indicating that the orbital period of CK Boo is increasing continuously by 0.149 s/century, and its orbital period was $0^{\text{d}}.35520$ in 1991.

Table I. The amplitudes of the light curve
and the average magnitude of colour index

Filter	Average Amplitude	Colour Index	Average Magnitude
U	0.30±0.02	U$-$B	-0.09 ± 0.05
B	0.27±0.01	B$-$V	$+0.02\pm0.04$
V	0.26±0.01		
Hβ(w)	0.25±0.02	β	-0.02 ± 0.04
Hβ(n)	0.28±0.02		

2

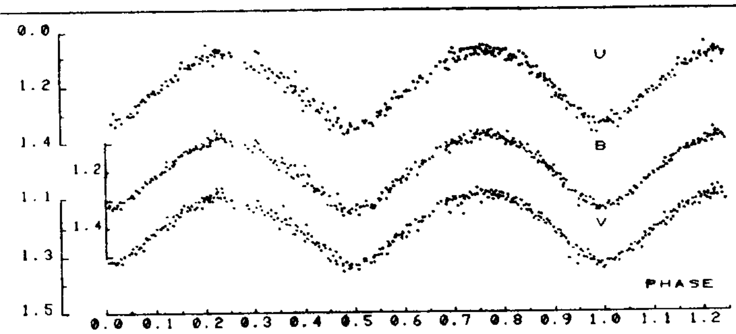

Figure 1 THE UBV LIGHT CURVES OF CK Boo

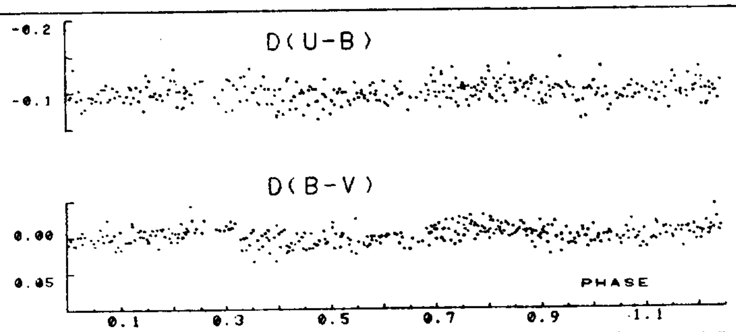

Figure 2 THE COLOUR INDEXES OF (U-B) AND (B-V) FOR CK Boo

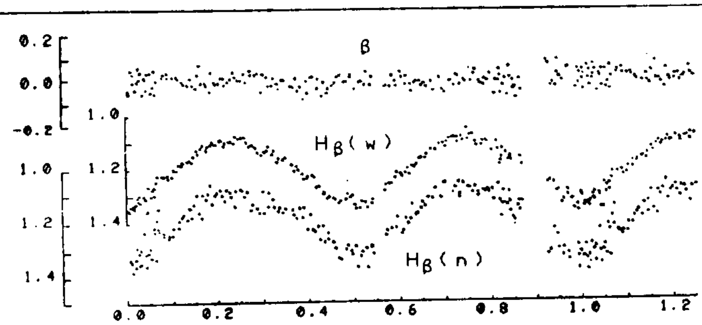

Figure 3 THE β INDEX CURVE, Hβ (w) AND Hβ (n) LIGHT CURVES OF CK Boo

Table 2. The minimum times of CK Boo

JD(hel) 2440000.0+	E	O-C (days)	Ref.	JD(hel) 2440000.0+	E	O-C (days)	Ref.
2537.4330	1013.5	0.0170	(1)	7291.4796	12372.5	0.0091	(5)
2897.3759	0.0	0.0000	(2)	7292.3699	12375.0	0.0115	(5)
2898.4418	3.0	0.0004	(2)	7298.4072	12392.0	0.0113	(5)
3225.5334	924.0	-0.0012	(2)	8362.0907	15387.0	0.0202	U*
3229.4409	935.0	-0.0003	(2)	8362.0913	15387.0	0.0208	B*
3230.5069	938.0	0.0002	(2)	8362.0908	15387.0	0.0203	V*
3341.3122	1250.0	-0.0013	(2)	8385.1797	15452.0	0.0244	U*
3573.5846	1904.0	0.0029	(2)	8385.1814	15452.0	0.0261	B*
3667.3400	2168.0	-0.0013	(2)	8385.1808	15452.0	0.0235	V*
3670.3610	2167.5	0.0009	(2)	8386.0668	15454.5	0.0237	U*
4753.3929	5226.0	0.0026	(3)	8388.0695	15454.5	0.0264	B*
4756.4161	5234.5	0.0070	(3)	8386.0664	15454.5	0.0233	V*
4790.3294	5330.0	0.0035	(3)	8388.2429	15455.0	0.0222	U*
5054.5625	6074.0	0.0049	(3)	8386.2434	15455.0	0.0227	B*
5057.5829	6082.5	0.0065	(3)	8386.2439	15455.0	0.0232	V*
5132.3408	6293.0	0.0053	(3)	8387.1319	15457.5	0.0273	U*
5140.3339	6315.5	0.0075	(3)	8387.1322	15457.5	0.0236	B*
6183.4110	9252.5	0.0088	(4)	8387.1321	15457.5	0.0235	V*
6183.4100	9252.5	0.0078	(4)	8388.1971	15460.5	0.0231	W*
7290.4153	12369.5	0.0102	(5)	8388.2002	15460.5	0.0262	N*
7290.4146	12369.5	0.0095	(5)				

(1) Bond (1975)
(2) Aslan (1978)
(3) Aslan and Derman (1986)
(4) Demircan (1987)
(5) Pajdosz and Zola (1988)
* this paper

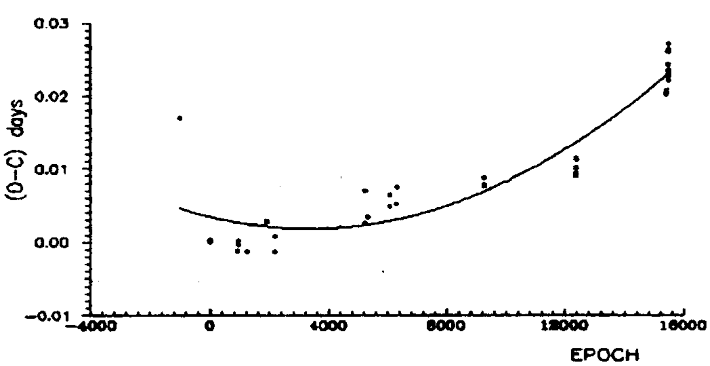

Figure 4 The (O-C) values of minimum times for CK Boo

The short time-scale light variations were analysed by auto-regression (AR) power spectral and Fourier method. There are no other significant short-term variations except the 4.3 hours period which is probably half the orbital period.

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Photometry of α Orionis (Nov 1990 to Apr 1992)

We present new photometry of Betelgeuse derived from differential measurements with respect to ϕ^2 Ori (= HR 1907, for which V = 4.09, B-V = 0.95). The color of Betelgeuse was taken to be B-V = 1.84, as given by the 4th edition of the *Bright Star Catalogue* (1982). Transformation to the UBV system was accomplished by means of transformation coefficients derived from differential measures of the red-blue pair 27 and 28 LMi (Hall 1983). From observations obtained over several years our system has $\epsilon_V = -0.054$, $\mu = 0.940$. The data were obtained at the 2800-m level of Mauna Kea, Hawaii, using a 15-cm Newtonian reflector, a DC photometer, and a strip chart recorder. The data are given in Table I. Previous data are given in Krisciunas and Fisher (1988) and Krisciunas (1990).

Table I

Photometry of α Orionis

Date	<UT>	Julian Date	V		B-V
13/14 Nov 1990	1032	2448209.94	0.475 ±	0.015	
27/28 Dec 1990	0623	8253.77	0.548	0.013	
3/4 Jan 1991	0700	8260.79	0.459	0.016	
20/21 Jan 1991	0643	8277.78	0.488	0.006	
6/7 Mar 1991	0656	8322.79	0.524	0.013	
3/4 Apr 1991	0659	8350.79	0.555	0.011	
12/13 Oct 1991	1144	8542.99	0.292	0.006	
9/10 Nov 1991	0920	8570.89	0.365	0.006	
26/27 Dec 1991	0750	8617.83	0.345	0.019	1.844
29/30 Dec 1991	0710	8620.80	0.352	0.004	
26/27 Jan 1992	0656	8648.79	0.352	0.012	
2/3 Feb 1992	1105	8655.96	0.320	0.023	
22/23 Mar 1992	0641	8704.78	0.394	0.018	
16/17 Apr 1992	0604	8729.75	0.423	0.008	

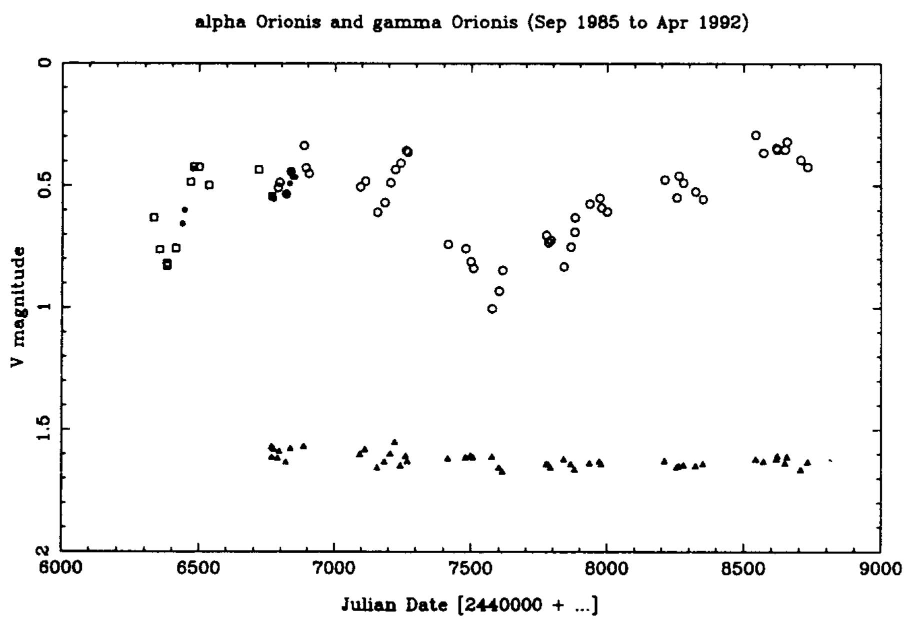

Fig. 1 - Data from Table I and from IBVS Numbers 3227 and 3477. Squares: α Ori data by Krisciunas reduced with respect to γ Ori. Dots: α Ori data by David Fisher, using ϕ^2 Ori as comparison star. Open circles: α Ori data by Krisciunas reduced with respect to ϕ^2 Ori. Filled triangles: γ Ori data reduced with respect to ϕ^2 Ori.

The check star was γ Ori (V = 1.64, B-V = -0.22), which in the 1987/88 season exhibited some evidence of variability on the order of 0.1 magnitude. Since then it has not shown any evidence of variability. The redder color of ϕ^2 Ori makes it a much better comparison star for Betelgeuse than γ Ori.

Because the light curve of Betelgeuse did not show great changes in the past two seasons, in Figure 1 we give the light curve over the past 6 1/2 years. This is greater than the principal period of variation, traditionally quoted as

5.781 years (Sanford 1933). The ≈420 day period of smaller amplitude, also observed photometrically by Dupree *et al.* (1987), and in radial velocity data by Smith, Patten, and Goldberg (1989) and by Dupree *et al.* (1990), seems to have diminished greatly in amplitude or to have died out.

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Photometry of α Tauri (Dec 1987 to Mar 1992)

According to the 4th edition of the *General Catalogue of Variable Stars* (1985-1990) α Tau (= Aldebaran = HR 1457) is of spectral type K5 III and varies irregularly from visual magnitude 0.95 to 0.75. The 4th edition of the Yale *Bright Star Catalogue* (1982) gives V = 0.85, B-V = 1.54 for α Tau.

In Table I we give photometry of α Tau on 13 photometric nights. For the most part differential photometry was carried out, with transformation to the UBV system by means of transformation coefficients derived from differential

Table I

Photometry of α Tau*

Date	<UT>	Julian Date	V		comp
27/28 Dec 1987	0728	2447157.81	0.926 ±	0.020	all sky
23/24 Jan 1988	0818	7184.84	0.887	0.013	β Ori
13/14 Feb 1988	0751	7205.83	0.892	0.015	β Ori
1/2 Mar 1988	0623	7222.77	0.869	0.022	all sky
13/14 Nov 1990	1009	8209.92	0.860	0.006	ε Tau
27/28 Dec 1990	0656	8253.79	0.875	0.008	"
3/4 Jan 1991	0617	8260.76	0.893	0.002	"
6/7 Mar 1991	0610	8322.76	0.875	0.015	"
12/13 Oct 1991	1127	8542.97	0.860	0.005	"
9/10 Nov 1991	0858	8570.87	0.893	0.018	"
29/30 Dec 1991	0651	8620.79	0.874	0.002	"
26/27 Jan 1992	0724	8648.81	0.886	0.005	"
22/23 Mar 1992	0604	8704.75	0.850	0.009	"

*From observations on 1/2 Mar 1988 and 3/4 Jan 1991, the mean B-V color was measured to be 1.549 ± 0.026.

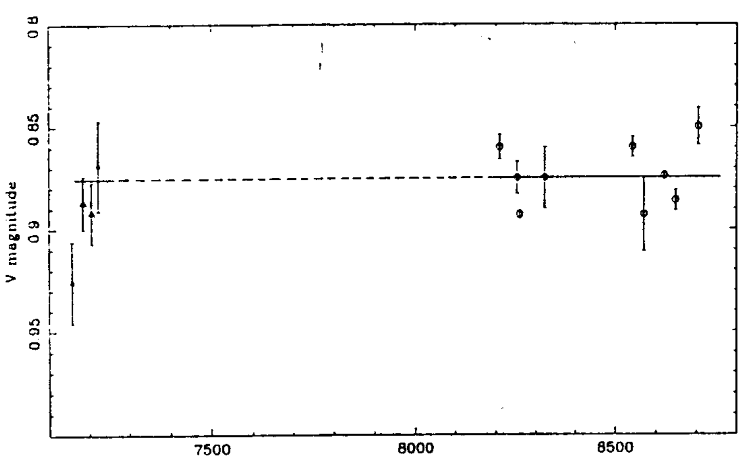

Figure 1 Data from Table I. Dots: V-band zero point derived from an average of 17 observations of standards per night. Triangles: β Ori used as comparison star. Open circles: ε Tau used as comparison star. The data were obtained at the 2800-m elevation of Mauna Kea, using a 6-inch reflector and a DC photoelectric system.

observations of the red-blue pair 27 and 28 LMi (Hall 1983). The comparison star β Ori has V = 0.12, B-V = -0.03 according to the *Bright Star Catalogue*, but Guinan *et al*. (1985) found it to be variable by as much as 0.16 mag. For the most part our data were reduced with respect to ε Tau (V = 3.53, B-V = 1.01). Typically 3 differential measures were made each night, but on some occasions up to 7 were made. The light curve is shown in Figure 1.

Since the night of 27/28 Dec 1987 α Tau seems to have been essentially constant in brightness at V = 0.876 ± 0.004. Excluding 27/28 Dec 1987, when α Tau was definitely fainter, the standard deviation of the distribution of the other points is only ±0.014 mag, consistent with no variations at all given the errors of the individual points. Of course, variations could have occurred during the 2 1/2 year gap in the light curve.

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HD 35155: The first eclipsing binary S star (P=642 days)

1. Binarity: a key property of chemically peculiar red giants

Binarity is a characteristic property of peculiar red giants like barium or Tc-deficient S stars (McClure et al. 1980, McClure 1983, Jorissen & Mayor 1988, Brown et al. 1990, McClure & Woodsworth 1990, Jorissen & Mayor 1992). Since their companions systematically appear to be white dwarfs (WD; Böhm-Vitense et al. 1984, Webbink 1986, McClure & Woodsworth 1990), the asymptotic giant branch progenitor of that WD is believed to have polluted the present red giant through mass transfer in a former evolutionary state of the binary system (e.g. Boffin & Jorissen 1988). In the present state of the system, the wind off the cool-giant primary may interact with the WD companion, as indicated by UV and IR (HeI $\lambda10830$) spectra of several S stars (see Johnson 1992 for a review). Given the similarities between the orbital elements of S and symbiotic stars (Jorissen 1992), it is in fact surprising that binary S stars do not show more conspicuous features of symbiotic stars, like emission lines in the visible part of the spectrum or outbursts. Johnson & Ake (1989) suggested that ER Del (=BD+8°4506) may be the first example of a symbiotic S star[1], since emission lines are not only found in the UV but also at Hα. Moreover, Ake et al. (1991; AJA91) showed that the S star HD 35155 behaves in the UV very much like a symbiotic system, with high-excitation emission lines (CIV, NV,...) and a variable continuum. This similarity is further strengthened by the results of the *uvby* monitoring of HD 35155 reported in the present short note, which confirms the suggestion by AJA91 that HD 35155 is an eclipsing-binary system.

2. Long-term photometric monitoring of the S star HD 35155

The S4,1 star HD 35155 ($V = 6.91$, $b - y = 1.17$) has been monitored since 1988, along with other peculiar red giants, in the framework of the *Long-Term Photometry of Variables* (LTPV) program (Sterken 1983) operating at ESO. All measurements will be published in the second LTPV catalog (see Manfroid et al. 1991a for the first one, which also gives details on the observations and the reduction procedures).

The comparison stars HR 1784 (G8III, $V = 4.14$, $b - y = 0.58$) and HD 37828 (K0, $V = 6.87$, $b - y = 0.73$), hereafter referred to as A and B, respectively, were used. Our differential photometry has good internal accuracy over long time spans, yielding a standard deviation of differential magnitudes and colors that amounts to only 0.005 mag over 4 years.

Figure 1 presents the differential y lightcurve of HD 35155, as a function of orbital phase computed from the orbital elements derived by Jorissen & Mayor (1992). An eclipse is visible around phase 0.13, in agreement with the spectroscopic ephemeris predicting the time of minimum light at phase 0.14 (±0.06). From the depth of the eclipse ($\Delta y \sim 0.14$) and from the magnitude $V = 7.0$ of the S star during eclipse, follows $V = 9.2$ for the magnitude of the eclipsed body. This corresponds to an absolute magnitude of about -1, since $M_{\rm bol} \sim -3$ for the S star (Eggen 1972; we assumed similar bolometric corrections). If that light were to originate from the photosphere of the companion, the latter should either be a hot main-sequence star, or a red giant. The former hypothesis is rejected on the basis of the small mass function derived for the system (Jorissen & Mayor 1992). A giant companion, on the other hand, could never account for the strong variations in the far UV continuum that were observed by

[1] not to be confused with S-type symbiotics, exhibiting photospheric IR colors at variance with D-type symbiotics which are dominated by dust emission in the IR

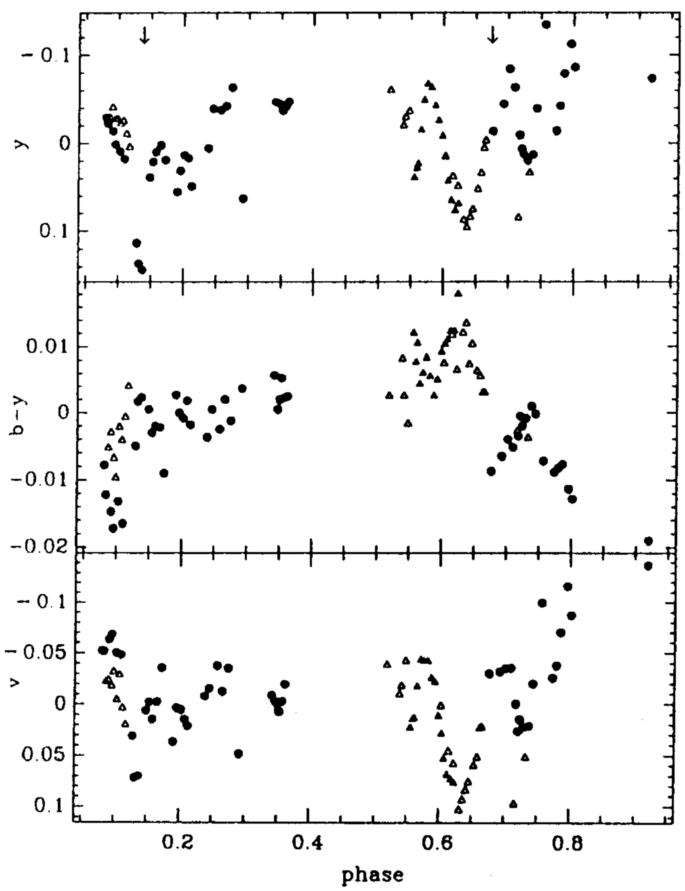

Figure 1: The y, $b-y$ and v differential (P-(A+B)/2) lightcurves of HD 35155 as a function of orbital phase. The orbital elements (P = 642 d, e = 0.07, ω = 214°, T = 2 445 494) are from Jorissen & Mayor (1992). Filled triangles correspond to the first cycle observed, whereas open triangles and dots respectively refer to cycle 2 and cycle 3. Magnitudes are plotted with respect to their average value over the whole monitoring. The arrows in the upper panel correspond to the spectroscopic ephemeris for eclipse and transit.

AJA91. In fact, *the eclipse is also present in the far UV*: among all IUE spectra obtained by AJA91, those corresponding to phases 0.09 and 0.13 (taken on August 5 and September 1, 1983, respectively) are the ones with the weakest continuum. It is thus beyond doubt that HD 35155 is an eclipsing binary system, with the eclipsed light being emitted close to the (WD) companion interacting with the giant's wind. The radial velocity V_2 of the UV CIII] and SiIII] lines observed by AJA91 suggests that these lines are tied to the companion ($V_2 \sim 60$ km s^{-1} at phase 0.46 while $V_1 = 86.3$ km s^{-1} and $V_0 = 79.7$ km s^{-1}, where indices 0, 1 and 2 respectively refer to velocities of the system, the giant star, and the companion). A mass ratio $M_1/M_2 = (V_0 - V_2)/(V_1 - V_0) \sim 3.0$ follows. Combining this value with the mass function of 0.028 $M_\odot$ derived by Jorissen & Mayor (1992) yields the relation $M_2 \sin^3 i = 0.45$ $M_\odot$. The eclipsing nature of the system requires in turn that $\sin i \geq 0.9$, so that $0.45 \leq M_2(M_\odot) \leq 0.6$. This analysis thus provides strong evidence that the companion is indeed a WD. Moreover, a mass $1.3 \leq M_1(M_\odot) \leq 1.8$ is derived for the S star, confirming the suggestion by Jorissen & Mayor (1992) that Tc-deficient S stars are *low-mass* stars on their way to the He-flash. These parameter values then yield $1.8 \leq A(\mathrm{AU}) \leq 2.0$ for the semi-major axis of the system. Assuming that the eclipsed light originates from a point source (AJA91 derive 4 $R_\odot$ for the CIII] emitting volume), the eclipse duration (≤ 0.04 in phase) implies that the S star has a radius of the order of 50 to 150 $R_\odot$, in agreement with the value of 100 $R_\odot$ deduced by AJA91 from the effective temperature and luminosity. The S star then lies well within its Roche radius ($R_1/R_{R,1} \sim 0.3$ to 0.7).

The spectral index of the eclipsed light implied by our *uvby* measurements appears rather surprising. A flux of 7.7 10^{-13} erg cm^{-2} s^{-1} Å^{-1} at 5500 Å follows from the magnitude $V = 9.2$ derived above and the absolute calibration of the Strömgrem photometry (taken from Lamla 1982). This flux is actually *larger* than the UV continuum observed by AJA91 (about 5 10^{-14} erg cm^{-2} s^{-1} Å^{-1} at 2000 Å) and does not fit the $f_\lambda \sim \lambda^{-1}$ law derived from that UV continuum. Moreover, the eclipse is equally deep in the y and b bands, but vanishes in the v band (Fig. 1). At 2000 Å, it is deep again, amounting to about 0.75 mag, as derived from the IUE fluxes during and outside eclipse.

Contrarily to Eggen (1972), who finds HD 35155 to be constant at the 0.1 mag level in V, our monitoring reveals variations outside eclipse as well. It is not clear yet whether these variations are caused by a pulsation of the stellar envelope, or whether they are related to the interacting nature of the binary system. The latter hypothesis is supported by the correlation between the visual magnitude measured by IUE and the level of UV activity reported by AJA91. Finally, there is a slight indication that the system looks redder when it is fainter (Fig. 1), a characteristic also seen in the case of the eclipsing-binary barium star HD 46407 (Jorissen et al. 1991).

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W DELPHINI
REQUEST FOR NEW OBSERVATIONS

As it is known, W Delphini is a semi-detached close binary system. It has been frequently observed and an unpublished list of primary minima was prepared by D. Lichtenknecker and F. Agerer. That is why a new study of the orbital period may be undertaken.

Years ago, Plavec (1960) considered that period variation of W Delphini could be caused by the apsidal motion. Then, this star was included among the semi-detached binary systems with "observed" apsidal motion.

From the actual list of primary minima, we have drawn the diagram of O-C residuals based on the linear formula:

$$\text{Min. Hel.} = \text{JD } 2418048.6187 + 4^{d}_{\cdot}8060633 \times \text{E}.$$

An inspection of O–C differences (see Figure 1) makes it evident that, if the corresponding curve is a periodic one, its period must be U>90 years; while in Plavec's paper, U$\simeq$51 years has been given for apsidal period.

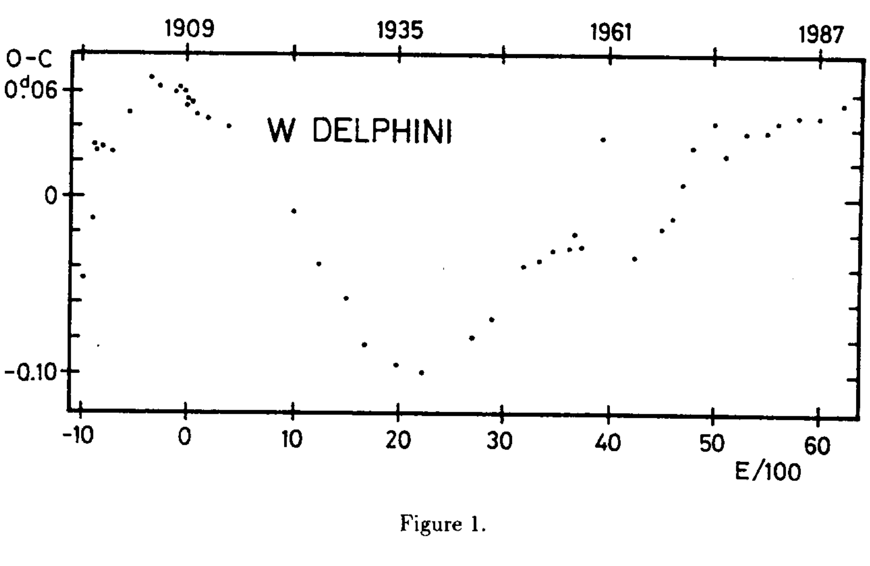

Figure 1.

As we can see in Figure 1, in order to determine an accurate value for the long period U, new series of primary minima are necessary. In addition, in order to accept or to reject the hypothesis of the apsidal motion, very accurate photometric observations of the secondary minima are necessary. Anyhow, in our days, there are many observers who could contribute to the study of the semi-detached system W Delphini.

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IS V410 CASSIOPEIAE A SYMBIOTIC STAR?

Variability of V410 Cas was discovered by Hoffmeister (1967), who pointed out that the star was bright in 1938–1939 ($15^m\!.5$ pg). Outside this time interval its brightness was $17^m\!.5$ - 18^mpg.

We studied this star on 409 photographic plates obtained with the 40-cm astrograph (Crimean Laboratory of Sternberg Astronomical Institute), J.D. 2437912–48180 (1962–1990).

We found that until 1978 the star was fainter than $17^m\!.5$ B, but after that it brightened to $15^m\!.5$ B in 1–1.5 years, and remained approximately constant during 10 years except a depression (16^mB) in 1981–82 (eclipse?). This photometric behavior is typical of such symbiotic stars as V1329 Cyg, HM Sge, PU Vul and other similar objects.

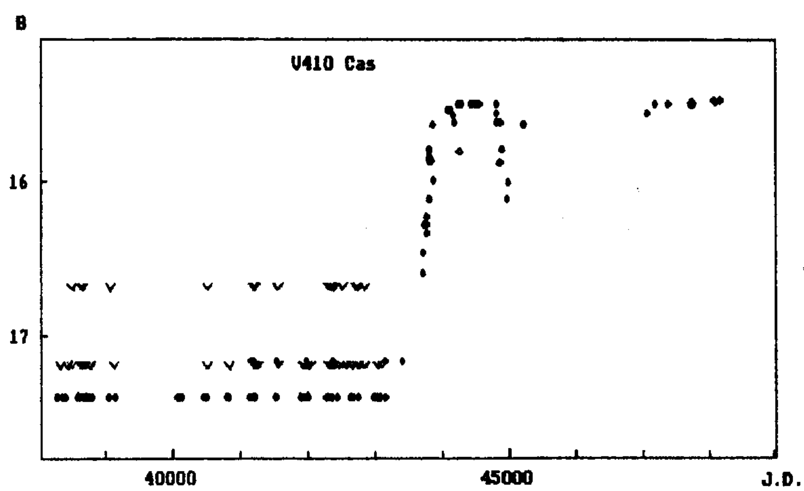

Figure 1. Light curve of V410 Cas in 1962–1990

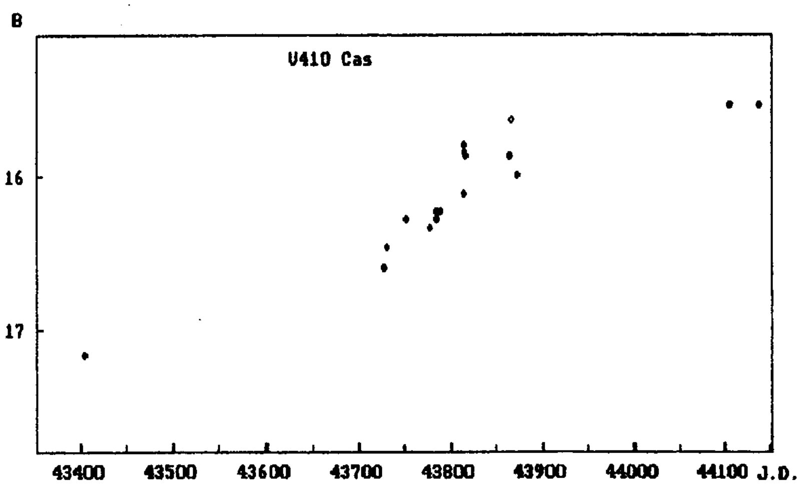

Figure 2. The brightness increase of V410 Cas in 1981–1982

It is significant that this particular star had two outbursts separated by 40 years.

According to the Palomar charts the star was about 18^{m}pg in 1954, on both the blue– and the red–sensitive prints. For a reliable classification spectral observations are needed.

The light curve and details of the brightness increase are given in Figures 1 and 2 respectively.

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IAU ARCHIVES OF UNPUBLISHED OBSERVATIONS OF VARIABLE STARS

The Archives of Unpublished Observations of Variable Stars was created to preserve and make available variable star data which are not published in scientific journals. Lengthy tables can be made available in the archives without the publication expenses. Additionally, observations which are not used in published papers may be of great use to other astronomers and can be made available through the archives. Information on existing files is published periodically in the Publications of the Astronomical Society of the Pacific (Breger 1979, 1981, 1985, 1988) and in the Bull. Inform. CDS (e.g. Jaschek and Breger 1988). Breger (1990) described how to submit and retrieve data from the archives. The submission of files electronically is now in place and working well. Further details regarding the submission and retrieval of files by electronic mail or on disk will be published in the near future.

The purpose of the present notice is to announce that Edward Schmidt has taken over from Michel Breger as coordinator of the archives. The procedures described previously should be followed except that communications with the coordinator should be directed to the following address:

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R Canis Majoris — Times of Eclipse Minima

R CMa is one of the nearest and best known systems of Algol-like general type. Its bright (mag 6) partially eclipsing light variation, with the relatively short period of 1.1359 days, makes it a productive astronomical target (Guinan, 1977).

An inherently peculiar group of 'R CMa stars' was once postulated (Kopal, 1959). Using 'reasonable' values for the mass ratio, and with a known 'mass function', the derived masses of stars in this group were far too low to allow them to accord with the normal mass-luminosity relation. Although part of this peculiarity has been removed (cf. eg. Okazaki, 1978), Algols with very low mass ratios *and at low periods* remain odd to interpret in terms of interactive evolution. R CMa is in a very peculiar position in this respect (Budding, 1985). Problems associated with this were recently revisited (Budding and Banks, 1991), in the light of Edalati *et al.*'s (1989) narrowband photometry, and Tomkin and Lambert's (1989) updated spectroscopic evidence.

From a study of the observed period changes, Radhakrishnan *et al.*, (1984) inferred the presence of a *third body* in the system with a mass of $\sim 0.5 M_{\odot}$, a period of about 90 years, the high eccentricity of 0.45, and semi-major axis of some 10^9 km. Such a third body could go a long way toward explaining the outstanding peculiarities of this and similar 'R CMa' systems. Radhakrishnan *et al.*'s solution predicts that the next periastron passage of the third body should take place over the next few years. If this is the case, then the time is right to start careful monitoring of the times of eclipse minima to confirm, or otherwise, this third body hypothesis.

The purpose of the present note is thus to alert and encourage observers about the situation, and to report observed times of minima to the above authors where conveniently possible. A comparison star which has been cited as reliable is BD $-15°$ 1734 = HD56405, with HD 56310 as a check (Guinan, 1977).

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ON THE ROTATION PERIOD OF HD 39576

HD 39576 ($\alpha = 5^h52^m16^s$, $\delta = -28°39'23"$, 2000.0, $V = 9.05$ mag) is a rapidly rotating, single-lined spectroscopic binary with a G1V (Houk 1982) primary component. The star exhibits moderately strong Ca II H and K emission and variable X-ray emission in the 1-13 keV energy range (Buckley et al. 1987). No orbital information is available, nor is there any published photometry. HD 39576 is listed as star number 46 in the "Catalog of Chromospherically Active Binary Stars" (Strassmeier et al. 1988). In this paper we report the discovery of its light variability and determine a preliminary rotation period of 2.7 days.

Our photometry was obtained with the Danish 50cm-SAT telescope at ESO, LaSilla in January 1992. Standardized Strömgren *uvby* measures were made differentially with respect to SAO 170938 (G0) as the comparison star, and to HD 39636 (G5) as the check star. Table 1 lists the differential *uvby* values with respect to SAO 170938. The data were examined for periodicity with standard period-finding programs, and we found the greatest reduction of the sum of the squares of the residuals at a period of 2.70±0.02 days. However, there are two other possible periods, separated by one-day intervals, which result in approximately equally good fits. These are likely two aliases of the 2.7-day period. A periodogram is shown in Fig. 1. The formal values of the full amplitudes in u, v, b, and y, are 0.058, 0.054. 0.047, and 0.036 mag, respectively. Figure 2 shows the light and color curves phased together with the 2.7-day period with an arbitrary initial epoch (HJD 2,448,630).

One high-resolution spectrum centered at 6160 Å (Fig. 3) was obtained at Kitt Peak National Observatory with the coudé feed telescope in April 1992. Grating A and camera 5 were used in second order with a 800-pixel TI CCD and had an effective wavelength resolution of 0.18 Å and a S/N ratio of approximately 100:1. From comparison of several unblended photospheric lines of HD 39576 with sky spectra of the Sun ($v \sin i \leq 1.7$ km s^{-1}; Soderblom et al. 1989), and an empirical relationship between FWHM and line broadening (Fekel et al. 1986), we derive $v \sin i$ for HD 39576 of 20±2 km s^{-1}. This value is substantially smaller than the estimate of 65±10 km s^{-1} by Buckley et al. (1987) from lower resolution spectra. In our one "red" spectrum, there is no trace of a secondary component.

Table 1: ESO photometry of HD 39576

HJD	Δu	Δv	Δb	Δy
8636.7567	-0.650	-0.647	-0.616	-0.617
8638.5512	-0.586	-0.605	-0.591	-0.579
8638.6255	-0.615	-0.609	-0.594	-0.586
8638.7666	-0.634	-0.630	-0.607	-0.599
8639.5451	-0.647	-0.649	-0.629	-0.609
8639.6344	-0.658	-0.647	-0.621	-0.602
8640.6358	-0.578	-0.590	-0.563	-0.561
8640.6992	-0.612	-0.603	-0.596	-0.594
8641.5461	-0.635	-0.634	-0.619	-0.595
8641.6317	-0.661	-0.640	-0.624	-0.603
8641.7465	-0.667	-0.659	-0.631	-0.601
8642.5469	-0.657	-0.635	-0.607	-0.588
8642.6572	-0.630	-0.634	-0.603	-0.603
8642.7575	-0.652	-0.634	-0.610	-0.617
8643.5458	-0.626	-0.607	-0.596	-0.577
8643.6608	-0.602	-0.610	-0.578	-0.562
8643.7294	-0.614	-0.593	-0.578	-0.576
8644.5477	-0.651	-0.644	-0.625	-0.606
8644.6451	-0.644	-0.644	-0.621	-0.609
8644.7559	-0.620	-0.631	-0.612	-0.595

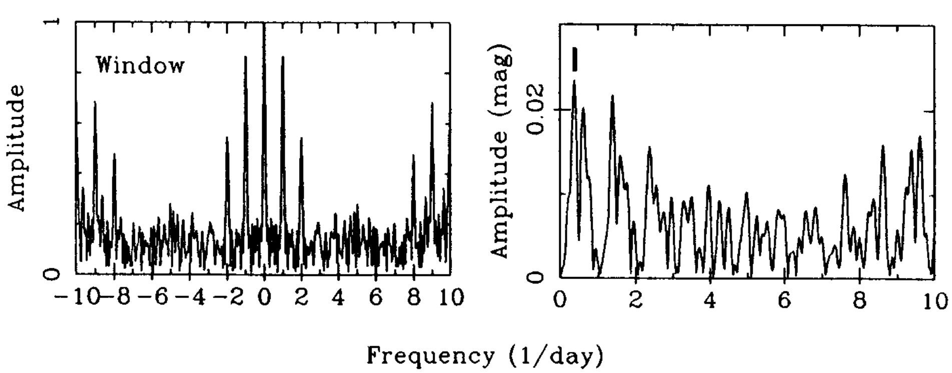

Figure 1: Periodogram for HD 39576 from b data (right panel). The left panel shows the window function. The period with the greatest reduction of the squares of the residuals is found at 2.7 days and is marked in the right panel.

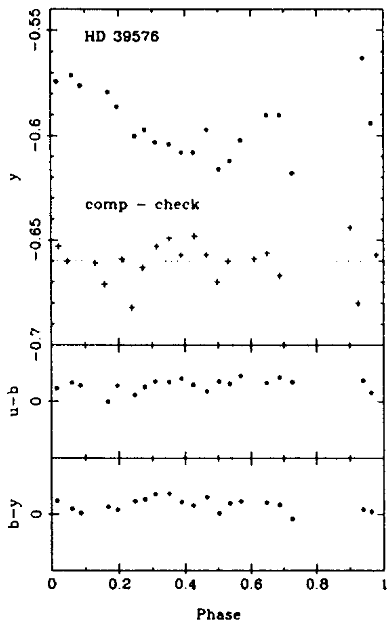

Figure 2: Strömgren *uvby* light and color curves of HD 39576. The data are phased with the ephemeris HJD 2,448,630+2.7×E.

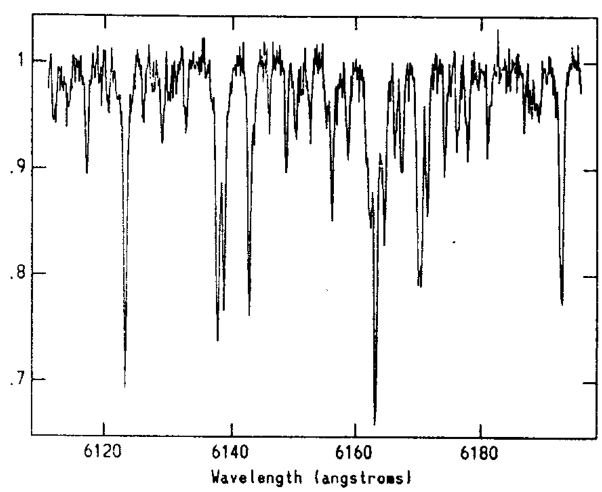

Figure 3: A high-resolution spectrum of HD 39576 centered at 6160 Å. $V \sin i$ is measured to be 20±2 km s^{-1}.

If we assume that the photometric period of 2.7 days is the rotation period, our $v \sin i$ measure translates into a minimum radius of 1.07±0.12 $R_\odot$. Accordingly, a 0.7 or 1.7-day period results in a minimum radius of 0.29 or 0.67 $R_\odot$, respectively. Several sources quote a typical radius of ≈ 1.1 $R_\odot$ for a G1 dwarf (e.g. Schmidt-Kaler 1982), which would be in agreement with our determination from the 2.7-day period. Clearly, a subgiant classification must be ruled out if the photometric period is not just a spurious value and the star is not viewed at a very low inclination. Since the overall appearance of the spectrum of HD 39576 is rather well matched by the G0V "standard" β CVn, and the temperature sensitive line-depth ratio Ti I 6146/Si I 6145 of 0.11±0.01 is exactly that of a G1 dwarf of $T_{\rm eff}$ = 5900 K (according to the calibration of Strassmeier et al. 1992), we believe that HD 39576 is indeed a dwarf star and that the 2.7-day period is likely to be the rotation period.

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IAU STANDARD STAR HD 42397 IS A DOUBLE-LINED BINARY

Twenty years ago, it was proposed by Heard and Fehrenbach (1972) to add about twenty stars of roughly eighth magnitude to the list of stars deemed to be suitable for use as radial velocity standards. These objects were adopted as such by the IAU, and most of them are currently included in the list of standards in the Astronomical Almanac.

Although Heard and Fehrenbach presented observations of their objects obtained from three observatories over three years, and thus felt fairly confident that they had eliminated obvious variables, observations of the K-type giants on their list by Griffin (1975) showed that at least one, HD 14969, was in fact variable, and he subsequently (Griffin 1980) published a spectroscopic orbit for that object. To my knowledge, however, no further observations of those giants have been published, and none at all of the F and G dwarfs which make up the rest of the list, save for a handful reported to the IAU by Heard in 1976.

I have for some years been making occasional observations of IAU radial velocity standard stars, including those of Heard and Fehrenbach, with the radial velocity spectrometer (Fletcher et al. 1982) at the coude focus of the Dominion Astrophysical Observatory's 1.2m telescope. Unfortunately Victoria's cloudy winter skies permit only infrequent observations of objects near six hours of right ascension. Prior to 1991, as a result, I had accumulated only four observations of HD 42397, none of which suggested anything unusual.

However, on 1991 February 3 (UT), the "dip" produced by the spectrometer for HD 42397 proved to be double, indeed well resolved, with the stronger component to the red. Soon thereafter, the star moved into the daytime sky, and I was unable to observe it again until the following September. It still appeared to be double then, with slightly larger separation and the stronger component still to the red. During the fall and winter of 1991-2 the separation gradually decreased, until in 1992 April the dips were no longer fully resolved by the spectrometer. The available observations are set out in Table I.

Although the observations were obtained through several different masks, those presented above have been adjusted by small amounts, in all cases less than 1.0 km/s, in an attempt to place them all on a standard system, which is thought to be very close to the IAU (Pearce 1957) system. Some of the adjustments have been published by Fletcher et al (1982), but others are my own unpublished ones. The uncertainty of a single observation is approximately 0.5 km/s.

Clearly it is impossible to obtain orbital elements from such a limited set of data, or even predict when next the spectra will be resolved, or indeed if they will ever be resolved with the stronger component to the blue. However, by comparing the average of the four

Table I — The Observations

Hel. J.D. 2440000+		Radial Velocity (km s^{-1}) (combined)		
5246.040		37.3		
5770.762		38.0		
7073.0542		38.9		
7878.8711		38.8		
	(component A)		(component B)	
8290.7711	47.0		26.9	
8521.0253	50.9		23.2	
8530.0165	50.0		25.3	
8585.8900	49.5		24.9	
8604.9400	50.0		25.4	
8606.8655	48.4		28.9	
8730.7263	46.3			(unresolved)
8735.7202	44.3			(unresolved)

early velocities, 38.2 km/s, with the averages of the six resolved velocities for each component, 49.3 km/s and 25.8 km/s for the primary and secondary respectively, we can estimate the mass ratio to be close to 0.9, which is roughly consistent with the approximate magnitude difference of 0.5 magnitudes, estimated from the dip areas. Both dips are of about the same width, and give no suggestion of rotational broadening.

I hope to continue to observe HD 42397 occasionally, in order to obtain more information about its orbit, but am publishing this short note now to encourage others to do likewise, and to warn those who might wish to use the object as a standard. It is of course possible that the period is very long, and that the pair may be resolvable in the future by interferometric techniques, and I commend it to the attention of the appropriate observers.

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A TIME OF MINIMUM AND ROTATIONAL VELOCITY FOR TT HYDRAE

TT Hya is a totally eclipsing Algol binary (B9.5 V + G9-K1 III-IV) with a seven-day period (Etzel 1988). Its spectrum shows prominent shell absorptions throughout the ultraviolet, which are probably formed in an accretion disk, and emission lines from an extended shell or wind during total eclipse (Plavec 1988). The existing ephemeris of Kulkarni and Abhyankar (1980),

$$\mathrm{HJD(Obs.)} = 2{,}424{,}615.388 + 6.95342913 \cdot \mathrm{E} \qquad (1)$$

is not especially well determined (see Etzel 1988). So, in preparation for making further IUE observations of TT Hya, we have observed it both photometrically and spectroscopically in the optical with the view of getting a more precise time of minimum.

Photometric observations in B and V were obtained on two nights in late April, 1992, with the 16-inch Vanderbilt-Tennessee State robotic telescope. Neither night was especially good photometrically, but data on the second clearly caught the star going through second contact into total eclipse, as shown in Figure 1. Since we have no observations of the rising branch of the eclipse, we have estimated the time of minimum by fitting a light curve calculated for the elements of Etzel (1988; Table IV with q=0.184 and the cool star filling its Roche lobe) to the observations. The resulting times are HJD 2,448,743.826 $\pm$ 0.004 for V and HJD 2,448,743.823 $\pm$ 0.004 for B, about one hour later than predicted by equation (1). We can use our time of minimum to obtain a slightly better ephemeris

$$\mathrm{HJD(Obs.)} = 2{,}448{,}743.825 + 6.9534414 \cdot \mathrm{E} \qquad (2)$$

which incorporates the time of minimum of Kulkarni and Abhyankar and Etzel's -0.0045-

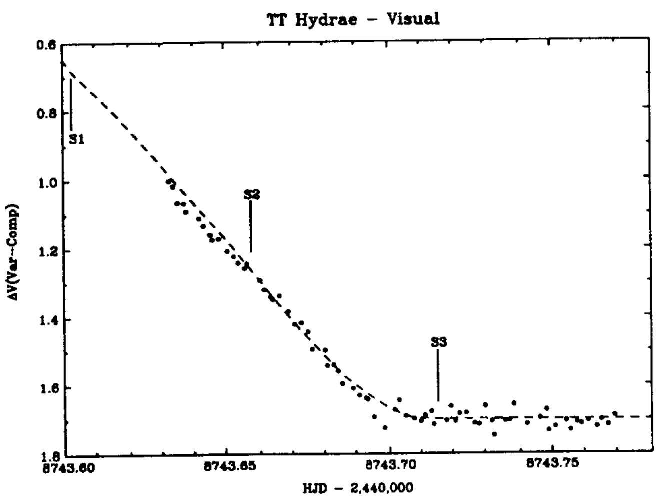

Figure 1. Observations of second contact of TT Hya made with the Vanderbilt-TSU robotic telescope. Magnitude differences are measured with respect to HD 97111, the same comparison star used by Kulkarni and Abhyankar. The dashed curve is the theoretically calculated light curve used to estimate the time of minimum. Phases of the three spectra taken in eclipse one orbit earlier are shown as vertical bars.

day correction to it. Observations for our first night were centered at phase 0.84. They can be used to determine the full amplitude of the light variation in the two colors: 1.77 mag in V and 2.58 mag in B. These are essentially the same as given by Etzel.

We also obtained spectra in the 6400-6480 Å range on three nights with the McMath Solar Telescope at the US National Solar Observatory. These had a dispersion of 0.09 Å/pixel and a resolution of about 1.5 pixels. Spectra were taken at phases 0.55 and 0.68 outside eclipse and at phases 0.968, 0.976, and 0.984 in primary eclipse. The last of these observations, shown in Figure 2, was made just after total eclipse had started, and it therefore records the light of the K star alone. The line broadening gives a rotational velocity of $v \sin i = 43 \pm 3$ km/s for a spherical star. Changes in equivalent widths of strong metallic lines over the phase range 0.68–0.984 are consistent with the changes in the fraction of the binary's light contributed by the K star.

Because our estimate of the rotational velocity is about twenty percent bigger than

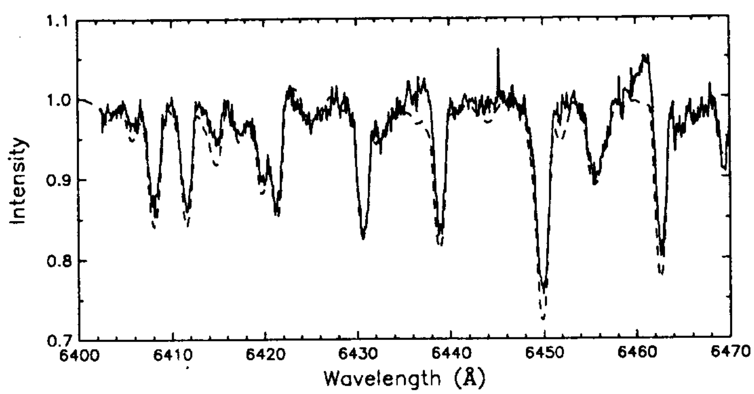

Figure 2. A spectrum of TT Hya made at phase 0.984 (solid line). This shows only the light of the K star, since the B star is totally eclipsed. The dashed curve is a spectrum of κ CrB broadened to simulate the velocity structure of the lobe-filling component of TT Hya; it has been shifted by +40 km/s to account for the difference in velocities of the two stars.

expected for synchronous rotation of a Roche lobe-filling component with the properties derived by Etzel, we decided to analyze the system more fully. To get a better idea of the geometry of the system, we have used a scheme previously applied to UU Cnc (Eaton, Hall, and Honeycutt 1991) to calculate the spectrum of the rotating, distorted lobe-filling component of TT Hya. In applying it, we took κ CrB (K1 IVa, $v\sin i < 5$ km/s, RV = -17 km/s) as the comparison star. When properly broadened for rotation, the stronger lines in κ CrB have equivalent widths about seven percent greater than in the K component of TT Hya. A comparison is given in Figure 2. Properties of the TT Hya system in total eclipse are especially simple. The only light detected comes from the K-giant component, which surely must be in contact with its Roche lobe. Thus the rotational velocity would depend uniquely on the mass ratio, the velocity amplitude of the cool, lobe-filling star, and the inclination. Because of the shell spectrum of the B star and its high rotational velocity, the amplitude of the hotter component's velocity curve, hence the mass ratio, has not been accurately determined. Popper (1982), however, has measured a velocity amplitude for the cool star, K_c = 130 km/s. Calculations in which the spectrum of κ CrB is broadened to simulate TT Hya show we do not get the observed rotational broadening for this velocity amplitude if we use the mass ratio (q=0.184) derived by Etzel for a lobe-filling component. Instead, we must raise the mass ratio to q=0.25 $\pm$ 0.02 at K_c = 130 or increase the the velocity amplitude to K_c = 145 $\pm$ 5 km/s (about 10%) at q = 0.184. For both of these cases the mass of the B star is increased slightly over the 2.25 $M_\odot$ found by Etzel and Popper, specifically to 2.5-3.1 $M_\odot$. Likewise, the radius of the K star would be about 5.6 $R_\odot$ in both cases. Some combination of these changes is indicated, although an increase in the velocity amplitude is favored slightly by the shift of the lines between the spectra in eclipse and the one for phase 0.68.

We also took an Hα spectrum at phase 0.11. It shows a broad, double-peaked emission component close to the velocity of the B star along with the weak rotationally broadened and redshifted spectrum of the K star. The emission component is 18 Å wide at its base and has a central reversal broad enough to be the the rotationally broadened absorption line of the B star.

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CONTINUING Hα SPECTROSCOPY OF CH CYGNI

The symbiotic star CH Cygni has been spectroscopically monitored at Ritter Observatory for several years. Our most recent report (Bopp 1990) discussed spectroscopy obtained between 1986 and June 1990, emphasizing data on the Hα profile acquired with our echelle spectrograph (resolution 0.3 Å). During 1986-1990 CH Cyg was in a quiescent state, declining in brightness to V=9.2 in the first part of 1990. The behavior of the Hα emission line over this interval was characterized by a general decrease in equivalent width (EW), as well as a narrowing of the profile (see also Bode et al. 1991).

In this report we present Hα data obtained between August 1990 and May 1992, noting in particular a dramatic increase in Hα EW and the reappearance of He I 6678 Å emission in the May 1992 data. This confirms the sudden increase in the activity level of CH Cyg originally reported by Skopal et al. (1992).

Most of our recent spectroscopic data on CH Cyg has been obtained with our Low Dispersion Spectrograph (LDS), which provides spectral resolutions of 1.2 to 6 Å depending on the grating used. The LDS uses a conventional optical layout, mounted on a Newport Corporation optical table. The spectrograph is coupled to the telescope focal plane by 20 meters of optical fiber; calibration flats, Neon comparisons, and starlight all follow the same optical path. The detector is a Wright Instruments CCD system with an EEV 385 x 578 pixel chip. At the 1.2 Å resolution used for the CH Cyg observations, the spectral coverage was about 350 Å; typical integration times were 10-20 minutes.

To quantify changes in Hα, we measured the line intensity and EW with respect to a local pseudo-continuum, and present results in Table 1. As we have previously noted, there appear to be 20-30% changes in both EW and intensity of Hα in CH Cyg that occur on a

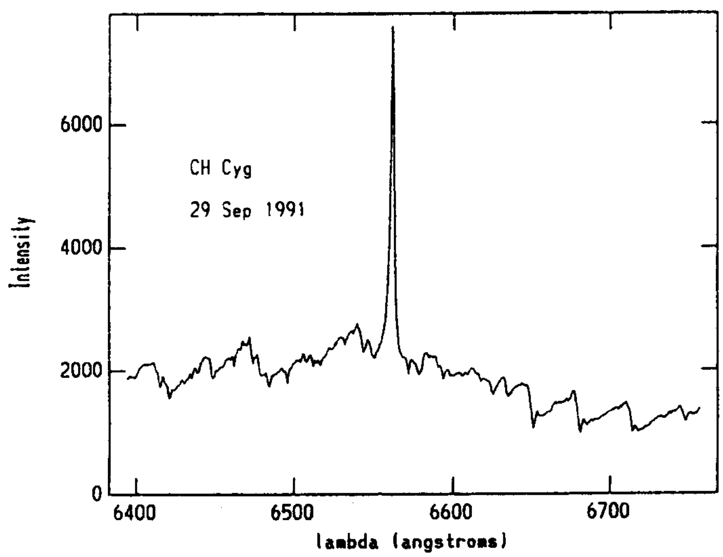

Figure 1: The red region of CH Cyg on 29 September 1991, showing a relatively weak Hα emission feature.

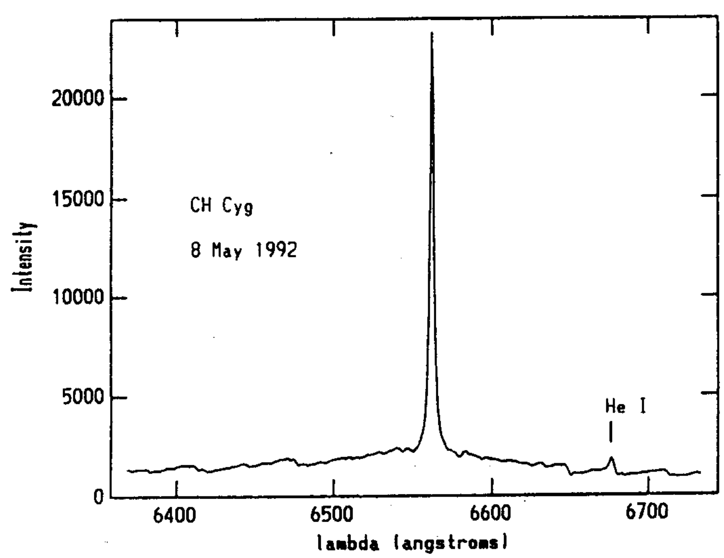

Figure 2: Hα in CH Cyg in May 1992, showing the enhanced emission line as well as He I 6678 Å emission.

Table 1

Hα Observations of CH Cyg

UT Date	EW(Å)	Intensity (x continuum)
25 Aug. 1990	20.4	6.3
5 Sep. 1990	26.1	8.0
21 Sep. 1991	11.7	4.8
29 Sep. 1991	7.7	3.2
14 Nov. 1991	12.2	4.7
8 May 1992	34.6	10.4

timescale of a few days or less. In September 1991, we recorded the weakest Hα in several years of monitoring, with an intensity only three times that of the continuum (Figure 1). No other emission lines were seen in this wavelength region during 1990-91.

CCD spectra from May 1992 (Figure 2) show dramatic spectral changes, and confirm the announcement by Skopal _et al_. (1992) that an outburst has begun. The Hα line is much more intense and broader; the EW has increased by a factor of three, and the He I 6678 Å line has appeared in emission. While not obvious on Figure 2, the He I line is considerably broader than the instrumental resolution, with a full width of nearly 300 km s^{-1}. Continued spectroscopic monitoring of CH Cyg through its outburst is planned.

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THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS (AAVSO) PHOTOELECTRIC PHOTOMETRY ARCHIVE

The AAVSO photoelectric photometry program was established about ten years ago by Janet A. Mattei and John R. Percy to obtain long-term, high-precision observations of stars with variations too small to be monitored by visual techniques. Some of these stars have larger-amplitude variations on one time scale, and smaller-amplitude variations on another. The original program included 51 semi-regular red variables, 6 yellow supergiants (RV Tau and SRd), and 13 variables of other or unknown kind. A few additional stars have subsequently been added, either by us or at the request of other astronomers. Most of the stars are between magnitudes 4 and 7; Betelgeuse is a very bright exception. They typically have amplitudes of a few tenths of a magnitude, time scales of weeks or months, and generally semi-regular or irregular light curves. All are well suited for long-term monitoring from small "backyard" observatories.

Howard J. Landis chairs the AAVSO's Photoelectric Photometry Committee, and also assists, advises and encourages the observers. He also reduces most of the data and archives it. John R. Percy co-ordinates the scientific aspects of the program, with advice from Janet A. Mattei, and edits the *AAVSO Photoelectric Newsletter* which is published three times a year.

The program has now produced over 7,000 observations. In addition to the observations of the "program stars" listed in Table 1, there are observations of about 30 small-amplitude red variables, obtained as part of "Project SARV" (Percy 1991a). Table 1 gives the name and position (epoch 2000) of each program star, the number of observations obtained in each year (and in total), the spectral type, the variable star type, range and period (from the *General Catalogue of Variable Stars*). The range is visual unless denoted B (blue) or p (photographic). The results of our observations of some of these stars (marked with an * in the last column) have been discussed in a brief review by Percy (1991b).

The following observers have contributed data to the archive:

Paul Beckmann (46), Bill Barksdale (246), Wayne Clark (95), Louis Cox (27), David Curott (402), Robert DeMartino (1), Frank Dempsey (150), Ales Dolzan (3), George Fortier (162), Guillermo Gonzalez (2), Robert Johnsson (54), Koster (deceased) (84), George Kohl (354), Paul Kneipp (82), Kenneth Luedeke (399), Howard Landis (1085), Thomas Langhans (266), Frank Mellilo (8), Russell Milton (688), Donald Pray (362), Mike Potter (17), Harry Powell (144), Luciano Pazzi (12), Gordon Ripley (6), Robert Reisenweber

TABLE 1: AAVSO PHOTOELECTRIC OBSERVATIONS TO DECEMBER 31, 1991

Name	RA (2000)	Dec. (2000)	1983	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL	SpT	Type	Range	Period
T CET	00^h 21.7^m	-20° 03'						2		10	6	18	M5IIe	SR	5.0-6.9	158.9
AG CET	00 27.7	-11 31						1				1	M4III	SRb	6.99-7.45	90:
TV PSC	00 28.0	+17 52	6			10	17	9	19	74	80	215	M3III	SR	4.65-5.42	49.1
EG AND	00 44.6	+40 40	8	1			6	7	9	7		38	gM2E	ZAnd	7.08-7.8	
Z ERI	02 47.9	-12 27						6	3	14	14	37	M4III	SRb	7.0-8.63B	80
RR ERI	02 52.2	-08 15						3	3	3	7	16	M5III	SRb	7.4-9.20B	97
RZ ARI	02 55.8	+18 18	9	2		20	9	25	25	45	45	180	M6III	SRb	5.62-6.01	30 *
ρ PER	03 05.1	+38 49	10	22		14	23	26	38	41	50	224	M4II-III	SRb	3.30-4.0	50: *
X PER	03 55.4	+31 03	11	5		4	11	25	24	10	10	100	Oe	γCas	6.03-7.0	
CE TAU	05 32.2	+18 35	7	4		28	31	17	54	26	13	180	M2Ib	SRc	4.23-4.54	165
α ORI	05 55.2	+07 23	2	1	10	1	10	19	11	30	22	106	M2Iab	SRc	0.0-1.3	2235
SS LEP	06 05.0	-16 27		2	1		1	46	15	12	4	81	AOVe+gM1	ZAnd	4.82-5.06	
η GEM	06 14.9	+22 30	4	2		23	31	34	39	51	41	225	M3III	SRa	3.15-3.9	232.9 *
IS GEM	06 49.7	+32 37	4	4		2	4	12	24	51	9	110	K0III	SRd	not variable	
V614 MON	07 01.0	-03 13		2			1	7	4	6	47	67	R5	SRb	7.01-7.36	60:
EW CMA	07 14.3	-26 21	1	4					4	7	1	17	Be	γCas	4.42-4.82	
VZ CAM	07 31.6	+82 24								1	1	2	M4III	SR	4.80-4.96	23.7
RU CAM	07 21.7	+69 39					2	3	9	1		15	K0-R2	WVir	8.10-9.79	22*
U MON	07 30.8	-09 46	1	4	9	11	16		12	33	14	100	F8eIb	RVTau	6.1-8.8p	91.32
AK HYA	08 39.9	-17 17		2	1					8	25	36	M4III	SRb	6.33-6.91	(75:)
RS CNC	09 10.6	+30 57	8	3			23	46	53	73	44	250	M6eIb	SRc?	6.2-7.7p	120: *
IN HYA	09 20.5	+00 10	18	5					1	12	20	56	gM4	SRb	6.27-6.87	65:
VY UMA	10 45.1	+67 24				9	56	11	14	24	10	124	$C6_3$(N1)	Lb	5.87-7.0	
VW UMA	10 59.1	+69 58				4	16	7	10	8	4	49	M2	SR	6.85-7.71	610
TV UMA	11 45.6	+35 53	4	3		1		5	1			14	M5III	SRb	6.75-7.34	42
GK COM	12 00.1	+19 25		3			1	9	2	12	6	33	gM4	SRb	6.84-7.13	50
FS COM	13 06.4	+22 37	10	4	58	28	70	77	49	77	55	428	M5III	SRb	5.30-6.1	58: *
SW VIR	13 14.1	-02 47	9	3		7		0	2	9	1	31	M6III	SRb	6.40-7.90	150:
FH VIR	13 16.4	+06 30	8	5				5			24	42	M6III	SRb	6.92-7.45	70:
FP VIR	13 35.9	+08 16	9	3				5	2	23	73	115	M4III	SRb	6.72-7.35	40:
EV VIR	14 13.2	-13 51	4	2							2	8	Mb	SRb	6.74-7.09	120:
W BOO	14 43.4	+26 31	11	10	35	17	44	60	42	119	140	478	M3III	SRb:	4.73-5.4	450: *
τ4 SER	15 36.5	+15 06	13	2		2	14			7	23	61	M4III	SRb	5.89-7.07	100:
ST HER	15 51.8	+48 29		6	4	2	1	15	13	10	2	53	M6III	SRb	8.8-10.3p	148.0
AT DRA	16 17.3	+59 46		2			1				12	15	M4III	Lb	6.8-7.5p	

AAVSO PEP OBSERVATIONS TO JANUARY 1, 1992

Name	RA (2000)	Dec. (2000)	1983	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL	SpT	Type	Range	Period
α SCO	16 29.4	-26 25	2	2				4	5	12	9	34	M1Ib	Lc	0.88-1.16	
AZ DRA	16 40.7	+72 40						1		8	1	10	M2III	Lb	8.0-8.9p	
VW DRA	17 16.5	+60 39					3	19	7	24	6	59	K0III	SRd:	not variable	
V449 SCO	17 37.0	-32 08								2		2	A2V	?	7.1p	constant?
V533 OPH	17 53.0	-02 35		2						4		6	Mc	SR:	8.3-9.3p	
V441 HER	17 55.6	+26 04		r	9		24	26	58	35	27	180	F2Ia	SRd	5.34-5.54	68: *
V2048 OPH	18 00.3	+04 22	1				9	16	19	35	22	102	B2Ve	γCas	4.55-4.85	
d SER	18 27.2	+00 12	3					42	24	14	9	92	GØIII+A6	?	5.17-5.29	*
AC HER	18 30.3	+21 52		10	16	17	11	10	10	11	2	87	F8	RVa	6.85-9.0	75.01
R LYR	18 55.3	+43 57	4	20	1	17	14	78	82	124	100	440	M5III	SRb	3.88-5.0	46: *
RY SGR	19 16.5	-33 31								39		39	GØ Iacp	RCrB	5.8-14.0	38.5
CH CYG	19 24.6	+50 15	2	1	1	21	49	55	25	11	4	169	Mb	SRb	5.60-8.49	
V973 CYG	19 44.8	+40 44						1	1	2		4	M3III	ZAnd	7.75-8.6B	
CSV 5011	20 03.0	+57 04					1	2	1	7		11	A0V	?	7.2-7.9p	
27 CYG	20 06.4	+35 58			26	16						42	KØIV	RSCVn?	5.36-5.39	
P CYG	20 17.8	+38 02			42	45	78	64	40	42	38	349	B2pe	SDor	4.70-4.90	*
EU DEL	20 37.9	+18 17	45	47	34	29	57	68	63	28	39	410	M6III	SRb	5.79-6.9	59.7 *
U DEL	20 45.5	+18 04					2	3	5	24	47	81	M5II-III	SRb	7.6-8.9p	110:
V832 CYG	20 59.8	+47 32					3		7	8	11	29	B1IVe	γCas	4.49-4.88	
FZ CEP	21 19.7	+55 26						3	1			4	M6III	SR	8.5-9.1p	
V1070 CYG	21 22.9	+40 56					6	2		6	1	15	M7III	SRb	6.5-8.5	
W CYG	21 36.0	+45 22		1	5	19	13	15	24	4	7	88	Mc	SRb	6.80-8.9B	131.1 *
AB CYG	21 36.6	+32 07		1	2	1	1	1	1		9	16	M4III	SRb	9.5-10.1p	520
V1339 CYG	21 42.2	+45 45			4	5	7	16	32	31	21	116	M4III	SRb	5.9-7.1	35:
μ CEP	21 43.5	+58 47				2	41	39	46	49	22	199	M2Ia	SRc	3.43-5.1	730
HK LAC	22 04.9	+47 05				15	2	28	2	2	2	51	K0III	RSCVn	6.77-7.04	25.83
DM CEP	22 08.3	+72 46							1			1	K7III	Lb	8.4-9.6p	
CSV 8775	22 33.7	+56 38					4	1	4	29	18	56	G8III-IV	?	5.6-6.8	
EW LAC	22 57.1	+48 41	2				2	10	15	16	8	53	B4e	γCas	5.22-5.48	
V509 CAS	23 00.1	+56 57				13	22	5	20	30	10	100	G0Ia	SRd	4.75-5.5	
SZ PSC	23 13.4	+02 42				12	2		1			15	F8K+K1	RSCVn	7.18-7.72	3.97...
χ AQR	23 16.8	-07 44					31	16	9	31	37	124	gM5	Lb	4.90-5.06	
λ AND	23 37.6	+46 27				23	42	52	10	16	37	180	G8III-IV	RSCVn	3.69-3.97	54.20
TX PSC	23 46.4	+03 30						3	4	32	74	113	C6(2)	Lb	4.79-5.20	
ρ CAS	23 54.4	+57 29	3	21		28	64	79	65	38	20	318	F8p	SRd	4.1-6.2	320 *
XZ PSC	23 54.8	+00 05				2	3	1	10	23	64	103	Mb	Lb	5.61-5.97	

(190), Donald Shannon (15), Douglas Slauson (16), Mike Smith (672), Lee Snyder (124), Jim Soder (deceased) (10), Hans Sorensen (228), Robert Schmidt (30), Raymond Thompson (387), Jim Waller (9), Paul Werner (1), David Williams (8), Jim Wood (948), Thomas Walker (38), Rick Wasatonic (154).

Copies of the data can be obtained on paper or diskette by writing to AAVSO Headquarters, 25 Birch Street, Cambridge MA 02138-1205, USA (phone (617) 354-0484; Fax (617) 354-0665, e-mail AAVSO@CFA8). There is a nominal charge to cover the handling and mailing of the data.

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COMMISSIONS 27 AND 42 OF THE IAU
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26 June 1992

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PHOTOGRAPHIC PHOTOMETRY OF THE MIRA STAR S ORI

The star S Ori is reported in the GCVS (Kholopov et al., 1985) as a Mira Ceti star with a period of 414.3 days, a spectral type of M6.5e - M9.5e and an amplitude of variation between V_{max} of $7^m.2$ and V_{min} of $14^m.0$.

The current photographic photometric values presented here were obtained from the plate collection of the INAOE at Tonantzintla, Mexico. Twenty four plates taken with the Schmidt camera in the U filter of Johnson's system in a time span from 1971 to 1978 were selected.

In order to obtain the variation of S Ori, a set of 16 standard stars from the catalogue of Andrews (1981) were considered. Table I lists the plates utilized, whereas Table II presents the standard stars. The apparent magnitudes of these stars cover the expected amplitude of variation of S Ori.

The image diameters of both the programme star and the standard stars were measured with the PDS microdensitometer of the INAOE. For the diameters determined in each plate, a least squares fit to a straight line was carried out. The mean percentual error of the measurements of the diameter of S Ori is of 0.032± 0.018 which yields an accuracy of each point of less than 0.1 mag.

The final magnitude values of S Ori as well as the corresponding HJD are presented in Table III. Figure 1 shows the magnitude variation with phase determined with the period proposed by Kholopov et al. (1985). The amplitude of variation of S Ori found is 5.6 mag within the limits 9.0 mag at maximum light and 14.4 mag at minimum.

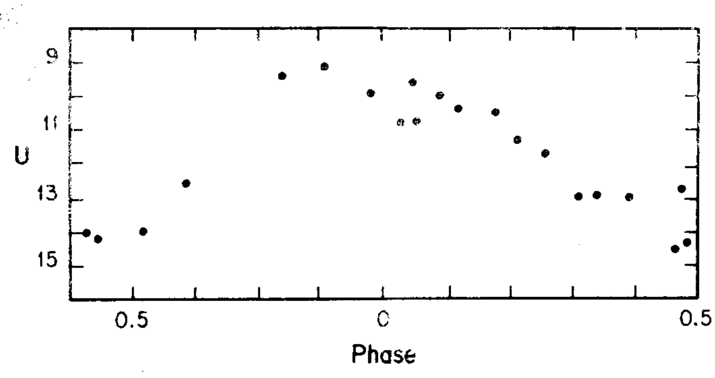

Figure 1. Phase diagram of S Ori. The period utilized is that of Kholopov et al. (1985).

Table 1. List of the utilized plates.

Plate	Date	Observer
ST5330	DEC 15/16,71	E. Chavira
ST5620	DEC 07/08,72	E. Chavira
ST5652	DEC 28/29,72	E. Chavira
ST5660	JAN 02/03,73	E. Chavira
ST6028	JAN 20/21,74	E. Chavira
ST6231	NOV 22/23,74	E. Chavira
ST6354	MAR 07/08,75	E. Chavira
ST6573	DEC 27/28,75	J. Campos
ST6615	FEB 21/22,76	E. Chavira
ST6655	MAR 04/05,76	E. Chavira
ST6669	MAR 32/24,76	E. Chavira
ST6921	DEC 21/22,76	J. Campos
ST6929	JAN 08/09,77	E. Chavira
ST6944	JAN 20/21,77	E. Chavira
ST6958	FEB 14/15,77	E. Chavira
ST6987	MAR 19/20,77	E. Chavira
ST7064	NOV 16/17,77	E. Chavira
ST7083	DEC 16/17,77	E. Chavira
ST7114	JAN 14/15,78	E. Chavira
ST7121	FEB 01/02,78	E. Chavira
ST7141	FEB 11/12,78	E. Chavira
ST7162	MAR 08/09,78	E. Chavira
ST7275	NOV 02/03,78	E. Chavira

Table 2. Standard Stars

No.	No. ANDREWS	U	B	V	PARENAGO or HD
1	92	---	8.88	8.82	HD36957
2	136	---	7.66	7.64	HD36629
3	139	---	13.47	11.87	P1049
4	140	12.03	---	11.52	P1179
5	141	15.07	15.04	14.03	P1092
6	144	1386	13.75	13.03	P1122
7	150	---	7.98	8.09	HD36842
8	165	---	14.95	13.80	P1143
9	9123	11.26	---	10.34	P1037
10	9128	13.64	12.47	11.12	P1036
11	7635	12.95	12.74	12.03	P1287
12	7598	14.05	13.46	12.59	P1304
13	6895	11.28	11.16	10.55	P1467
14	6933	13.97	13.51	12.73	P1523
15	6880	15.12	---	13.33	P1582
16	6252	6.88	7.44	7.56	HD36936

Table 3. Photographic Photometry of S Ori

HJD-24000	U
1301.8656	13.835
1659.8427	14.190
1680.8112	14.003
1685.7843	14.150
2068.8037	12.566
2374.7996	11.207
2479.6043	14.380
2830.6423	12.916
2842.6129	12.804
2861.5784	12.890
3134.7167	9.550
3152.5626	9.884
3164.5981	10.294
3189.7034	10.375
3222.5666	11.637
3464.8674	9.408
3494.8608	9.086
3523.7515	9.838
3541.7064	10.690
3551.5723	10.616
3576.5716	10.269
3815.7545	12.497

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THE LIGHT CURVE OF THE Ap VARIABLE HD 153947≡V974 Sco*

The variability of HD 153947≡NGC 6281–9≡V974 Sco was pointed out by North et al. (1988); Feinstein & Forte (1974) did not support its membership to NGC 6281, while Bolton & Herbst (1976) and North et al. (1988) considered it an open question. The latter authors also reported a photometric period of 2.662±0.003 d; from their Fig. 1 a time of maximum light at HJD 2446966.96±0.05 can be derived.

In April and May 1992 we observed the δ Scuti star V922 Sco, located near NGC 6281, with the ESO 50–cm telescope and we decided to include V974 Sco in the observing cycle. On each night, 5–8 measurements were collected and grouped into the 11 normal points listed in the table. The V standard magnitudes were calculated assuming V=7.444 for the comparison star HD 153426, as obtained from the observation of some nearby standard stars. V974 Sco has a faint companion star, located about 18 arcsec further east and not previously reported: we measured a difference of 3.8 mag in V-light.

The period search was performed using a least–squares method and we were able to confirm the photometric period reported by North et al. (1988). The figure shows the normal points with the interpolating light curve, calculated by including also the first harmonic $2f$. The V light amplitude is 0.06 mag, in good agreement with the 0.07 mag amplitude reported by North et al. (1988). The derived time of maximum is HJD 2448740.72 ±0.03; the elapsed cycles from North et al. 's maximum should be 666, giving a period of 2.6633±0.0001 d, but 665 or 667 cycles are also possible. The standard deviation of the fit is 0.0055 mag: this value is 2–3 times greater than the expected one. This discrepancy can be due to the contaminating light from the close companion, only a few arcseconds outside the diaphragm field, or to a slight variability of HD 153426≡NSV 08104.

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* Based on observations collected at European Southern Observatory, La Silla, Chile

Table I

Hel. J.D.	V	Hel. J.D.	V	Hel. J.D.	V
2448732.88	8.759	2448743.83	8.780	2448746.80	8.804
8734.73	8.797	8743.91	8.789	8746.87	8.805
8735.89	8.796	8745.82	8.779	8746.91	8.807
8736.87	8.826	8745.91	8.762		

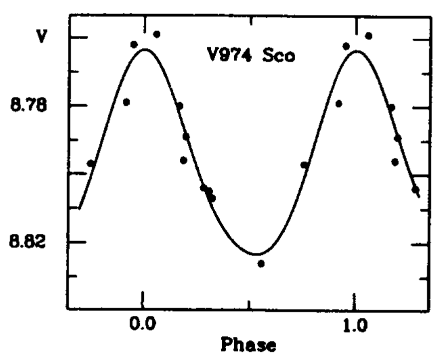

Figure 1

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CH Cygni in 1992: the strongest activity after the large outburst in 1977-1986

CH Cyg is a symbiotic binary consisting of an M giant semiregular variable and a white dwarf probably possessing strong magnetic field (Mikolajewski et al. 1990). Since 1989, the star has shown some episodes of erratic activity (e.g. Mikolajewski et al. 1990; Leedjarv 1990; Bode et al. 1991; Tomov and Mikolajewski 1992). In particular, two transitory (~ 1-2 months) maxima of *UBV* color indices related to reappearance of the hot

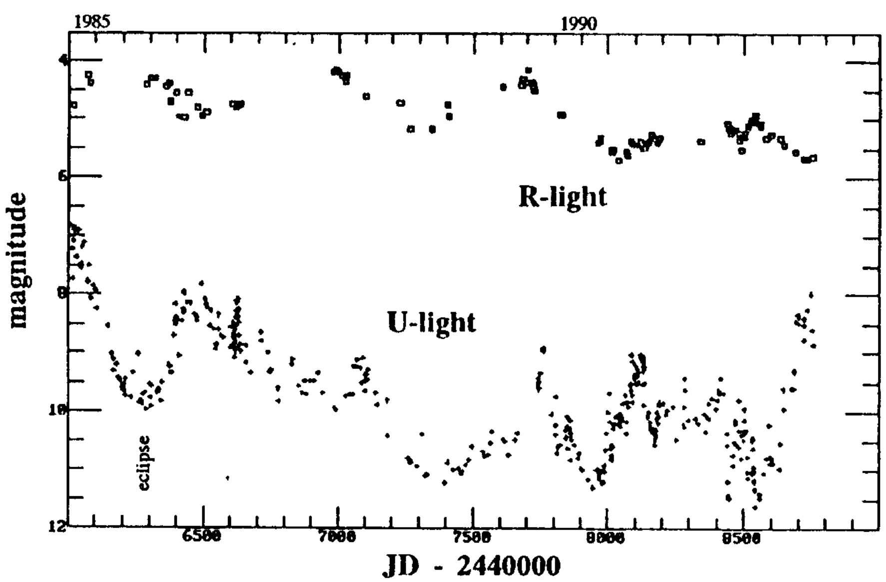

Figure 1. The *UR* light curves of CH Cyg during 1985-1992, mostly based on data obtained at Tartu, Toruń and Byurakan Observatories (Tomov et al. 1992, in preparation).

continuum were observed in 1989, and two more pronounced events happened in 1990–1991 (Fig. 1). The periods of increased brightness were also accompanied by flickering activity and remarkable changes in the emission line spectrum.

In the beginning of 1992, the hot continuum started to grow up again. In March-April 1992, the *U* magnitude was about $8^{m}.5$, which means that the hot continuum was as strong as that observed in 1986, shortly before the end of the 1977-1986 outburst (Fig. 1). At the same time, the cool giant was close to minimum of its 770^{d} variability as indicated by low *RI* magnitudes ($R \approx 5^{m}.6$; $I \approx 3^{m}.2$), and spectral type between M7 and M8 derived from the VO absorption (Bode et al. 1991). Mikołajewski, Mikołajewska and Khudyakova (1992) have recently suggested that this variability can be due to rotation of the giant's photosphere covered with a large dark spot. Although the hot component brightness is comparable to that observed in 1986, the very low brightness of the M giant causes the spectrum in the *UB* range to be dominated by the hot component. In fact, even the most prominent spectral features of the M giant (e.g. CaI 4227Å and TiO bands) are practically fully veiled by the hot continuum (Fig.2), and the flickering variability characteristic of the hot source is visible in *U* band (Fig. 3) and even in *BV* bands.

The optical spectra taken in 1992 were characterized by very bright HI Balmer lines, strong He I and relatively weak [Fe II] and Fe II emission lines (e.g. comparing with 1986, when the overall intensity of the hot spectrum was comparable), as well as the presence of forbidden [O III], [Ne III] and [S II] lines. Ca II "H" and "K" emission lines with core absorptions were stronger than anytime before. It was surprising that H_8 had similar profile, with blue-shifted absorption component of increasing strength. Unfortunately, we do not have any idea about the origin of this strange H_8 profile. All remaining HI Balmer lines had single component profiles without any trace of absorptions. Between January and April 1992, intensities of the Balmer emission lines and continuum as well as of the other permitted lines have been growing up, while the forbidden line fluxes have been slightly decreasing or constant (Fig. 2).

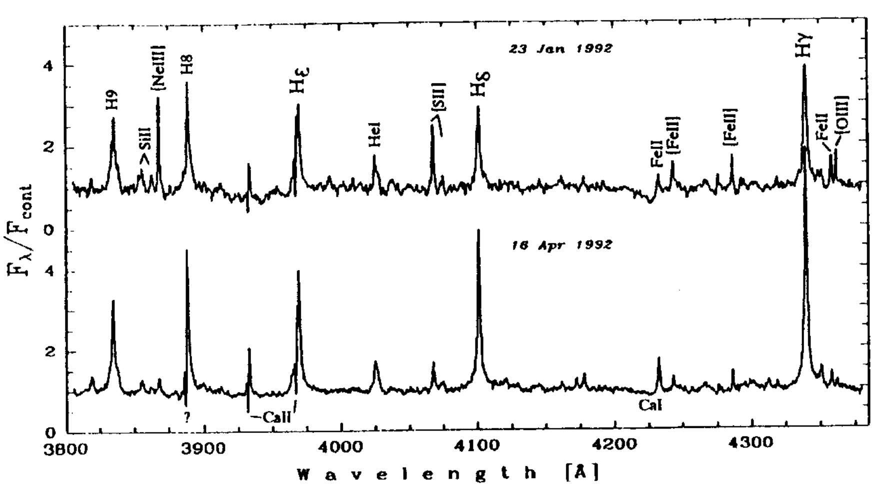

Figure 2. Coude-spectra (0.35Å) of CH Cyg obtained at Rozhen Observatory.

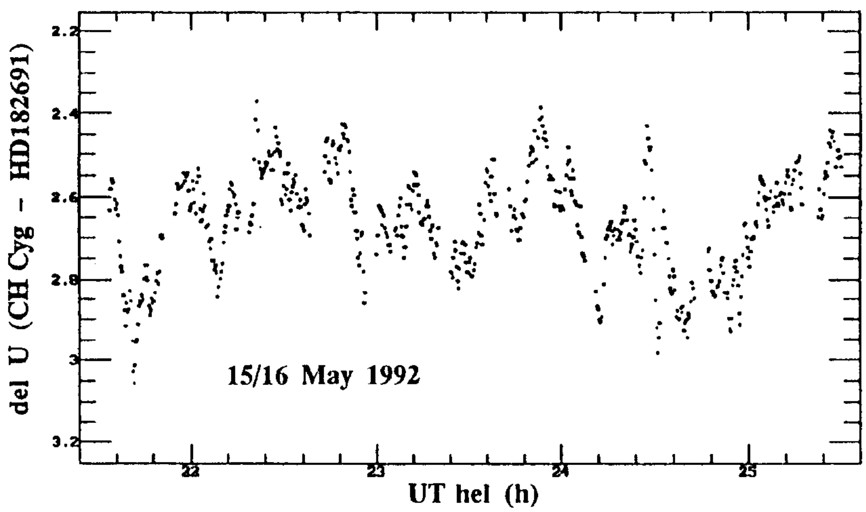

Figure 3. Flickering in *U* light, observed with two-channel photometer and 60cm telescope at Mt.Suhora Observatory. Rapid fluctuations with an amplitude of 30 ÷ 50% and a timescale of minutes are clearly visible.

The erratic activity of the hot component in 1989–1992 was unrelated to the M giant behavior. In particular, the 1989 summer episode coincided with maximum brightness of the giant, while the present one occurred during its minimum. This activity rather results from highly unstable physical conditions near the white dwarf. After the jet ejection in 1984, the accretion complex around the magnetic white dwarf was practically disrupted (Mikolajewski, Mikolajewska and Khudyakova 1990). At present, matter accreted from the giant's wind falls directly onto magnetosphere, causing the observed phenomena. In fact, strong HI Balmer emission, presence of nebular [O III] and [Ne III] emission, and especially the profiles of prominent Ca II "H" and "K" emissions, indicate strong outflow of matter, which can be due to propeller interaction of the rapidly rotating magnetic white dwarf with the giant's wind (see Mikolajewski et al. 1990 for details of the model).

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THE SVS NUMBERING SERIES DISCONTINUED

Herewith we announce that the numbering series SVS ("Soviet Variable Stars") are not continued after December, 1991. The series starts with SVS 1 = NSV 06227 (J. Balanowsky, *Astron. Nachr.*, 1918, **208**, 34) and its last number is SVS 2887 (M.G. Smekhov, *Astron. Tsirk.*, 1991, No.1550). Astronomers of many now independent states of the former Soviet Union contributed to this sequence. The greatest numbers of variables were discovered in Armenia, Georgia, Latvia, Lithuania, Russia, Tadjikistan. For historical reasons the group responsible for the General Catalogue of Variable Stars also attributed SVS numbers.

The majority of countries where variable stars are discovered do not have their national numbering sequences for preliminary designations of variable stars. On the contrary, many observatories have such numbering systems. We feel that the GCVS group has no right to introduce any new numbering for variables to be discovered in Russia or in the Commonwealth of Independent States; moreover, it is not clear if such a system would really be useful.

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FY PERSEI IS A SHORT PERIOD CATACLYSMIC VARIABLE

The variability of FY Per was discovered by Morgenroth (1936). The history of the star's investigation, the preliminary results of photometric observations, the identification chart and the magnitudes of nearby stars are given in Shugarov (1980).

We obtained more than 400 UBV photoelectric observations during 1980 - 1992. The analysis of the observations revealed that the star showed a small outburst. The outburst duration is about 20^d. The brightness range is $12^m.3$ - $13^m.5$ in B.

The average color indices are B–V$\approx +0^m.3$, U–B$\approx -0^m.5$, that is typical for the cataclysmic stars.

The treatment of the observations shows that the system's light changes with the short period of about $1^h33^m$and the amplitude of about $0^m.15$.

For the analysis of the light curve we calculated the magnitude deviations from the average nightly values, beeause the light of FY Per changes from night to night.

The light curve for such deviations constructed with the following elements:

J.D. min. = 2447494.4403+$0^d.0648479\times$E

is given in Figure 1.

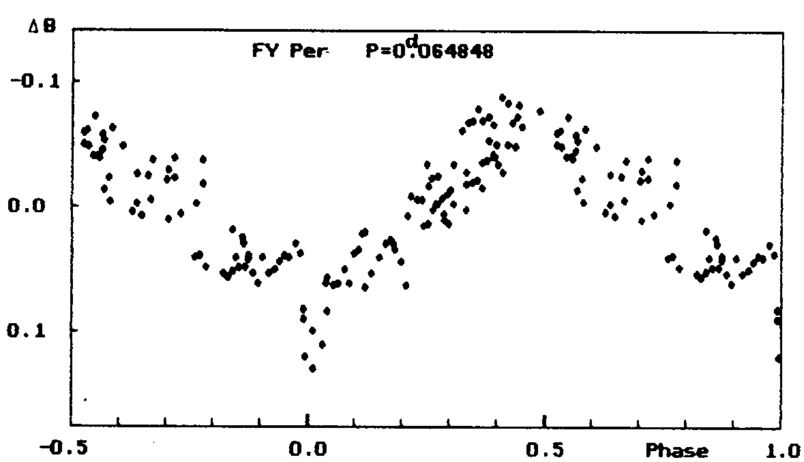

Figure 1. The mean light curve of FY Per.

Note that in some night the above period was not revealed.

In the nearest future we intend to publish a more detailed light curve in the different photometric systems and make a comprehensive analysis of the outburst activity.

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UBV - Observations of the Recent Outbursts of Three Cataclysmic Variables

In this contribution I report about results of *UBV* measurements of three outbursting cataclysmic variables, namely Nova Pup 1991, HV Vir and OY Car, which were observed as targets of opportunity at the ESO 1-m-telescope on La Silla between 1992, April 16 and 25.

All observations were obtained sequentially with the one-channel photometer. Measurements of E-region stars were used to tie the instrumental system into the standard UBV system. The formal accuracy of the transformation was found to be of the order of $0\overset{m}{.}01$ in all passbands. However, the extraordinary colours which make cataclysmic variables bluer than the available standard stars may introduce an additional transformation error. The results of the photometry of the three target stars are given in Table 1. The errors quoted there were derived mostly from counting statistics (but see the case of OY Car below) and do not contain the contribution of the standard transformation.

Nova Pup 1991 was detected by Camilleri (1992). *UBV* photometric measurements are reported by Gilmore (1992). A visual light curve was published by the AAVSO (AAVSO alert note 156 (1992)). According to these measurements, Nova Pup 1991 is a moderately fast nova. The present observations indicate a slight decline of the star over a time base of nine days. The present magnitudes and colours are significantly brighter and redder that those obtained at the same epoch by Gilmore (IAU Circ. No. 5527) who found $V = 11.15$, $B - V = 0.13$, $U - B = -0.75$ on April 19.40. The difference cannot be explained by accidental measurement errors but indicate a severe difference of the photometric systems.

HV Vir was classified as a classical nova which had its outburst in 1929 (see Duerbeck 1987). The present outburst was detected by Schmeer (1992) on 1992, April 19.917. The characteristics reported in IAU Circ. Nos. 5503, 5505, 5509, 5516 and 5517 leave no doubt that the star must be reclassified as a dwarf nova of WZ Sge type. The present observations started on 1992, April 23.135 and could only be continued until April 25.265. During this time, HV Vir declined gradually. Outbursts of WZ Sge stars have all properties of superoutbursts of SU UMa stars. A comparison of the colours of HV Vir with those of SU UMa systems in superoutburst (Bruch 1984) indicates that it is slightly bluer in $B - V$ than the SU UMa stars, but significantly bluer in $U - B$. Results of time series observations of HV Vir in white light on 1992 Apr. 23 and 24 will be reported in more detail at another place.

OY Car was undergoing a superoutburst which started on 1992, April 7 (Horne 1992). Light curves in *UBV* were observed on April 16, 19 and 20. On April 23 and 24, white light observations were undertaken, complemented by a few *UBV* measurements. On April 24, a single *UBV* measurement was obtained. Here, I report only about the night-to-night variations of magnitude and colours, postponing an analysis of the light curves of the individual nights to a later publication. For April 16, 19 and 20, Table 1 contains mean out of eclipse magnitudes and colours. In this case the quoted errors are standard deviations, calculated from the individual

Table 1: $UBV-$ data on Nova Pup 1991, HV Vir and OY Car

Name	Date (1992)	UT	J.D. 2448700+	V	$B-V$	$U-B$
Nova Pup 1991	Apr. 16	0:58	28.540	10.94 ±0.02	0.27 ±0.01	−0.56 ±0.01
	Apr. 19	1:52	31.578	10.93 ±0.01	0.26 ±0.01	−0.57 ±0.01
	Apr. 20	0:11	32.508	10.96 ±0.01	0.29 ±0.01	−0.57 ±0.01
	Apr. 22	23:43	35.488	10.98 ±0.01	0.27 ±0.01	−0.60 ±0.01
	Apr. 23	23:55	36.497	11.00 ±0.01	0.27 ±0.01	−0.60 ±0.01
	Apr. 24	23:48	37.492	10.98 ±0.01	0.23 ±0.01	−0.59 ±0.01
HV Vir	Apr. 23	3:15	35.635	12.12 ±0.02	−0.14 ±0.02	−0.93 ±0.02
	Apr. 24	2:49	36.617	12.44 ±0.02	−0.13 ±0.02	−0.91 ±0.02
	Apr. 24	6:54	36.788	12.47 ±0.01	−0.09 ±0.02	−0.90 ±0.02
	Apr. 25	6:21	37.765	12.63 ±0.01	−0.08 ±0.01	−0.87 ±0.01
OY Car	Apr. 16	1:42 – 2:12	28.571 – 28.592	12.26 ±0.07	0.04 ±0.06	−0.86 ±0.08
	Apr. 19	2:27 – 5:12	31.602 – 31.717	12.74 ±0.08	0.07 ±0.04	−0.63 ±0.07
	Apr. 20	0:18 – 3:54	32.5013 – 32.663	12.65 ±0.11	0.08 ±0.04	−0.71 ±0.07
	Apr. 23	0:00	35.500	12.97 ±0.03	0.05 ±0.01	−0.79 ±0.04
	Apr. 24	0:12	36.508	13.54 ±0.07	0.04 ±0.04	−0.87 ±0.03
	Apr. 24	2:21	36.598	13.73 ±0.03	0.00 ±0.05	−0.99 ±0.04
	Apr. 25	0:14	37.510	15.20 ±0.08	0.19 ±0.12	−1.06 ±0.12

UBV-measurements and are dominated by flickering activity and in particular by the effect of superhumps. They are therefore larger than the errors quoted otherwise in Table 1. In the course of time, OY Car shows a marked decline from superoutburst maximum, until on April 25 it had almost reached its quiescent magnitude which Vogt (1981) observed to be at $V = 15.55$. The colours during outburst as well as those close to quiescence differ somewhat from values observed at other epochs at similar phases (Vogt 1981). Moreover, $U - B$ shows a marked variability during the course of the outburst.

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THE POSSIBLE ECLIPSES IN THE T TAURI SPECTROSCOPIC BINARY SYSTEM GW ORIONIS

Mathieu et al. (1991) discovered that the classical T Tauri star GW Ori is a spectroscopic binary with an orbital period of 242 days. Besides, they described the properties of GW Ori including the spectral energy distribution in the near- and far-infrared regions. The mass function is $f(M)=0.026\ M_\odot$ and the orbital amplitude is $K=4.7\pm0.3$ km/s. Bouvier and Bertout (1989) detected the rotation modulation period P=3.25 days and the axial velocity $vsini = 43.0\pm2.5$ km/s for GW Ori. The view angle i_o between the rotation axis and the line of sight was computed by Bouvier and Bertout (1989) using these two quantities as well as the stellar radius. The latter was calculated from the bolometric luminosity and the effective temperature of the star ($R=8.5R_\odot$, $L=110L_\odot$, $T_e=5660$ °K, $i_o=15°\pm1°$). Mathieu et al. (1991) found the inclination angle of the spectroscopic orbital plane to be $15°<i<60°$ and assumed a primary mass of $M_1=2.5M_\odot$ and the secondary mass $0.31<M_2<1.27M_\odot$. Neither value of the inclination angle (i_o, i) permits an eclipse observation in GW Ori binary system.

At the same time we have detected several Algol-like light fadings close to spectroscopic phase 0.00 on the photoelectric light curve.

Our observations of GW Ori have been carried out since 1987 at the Mt. Maidanak using 0.6-m and 0.5-m reflectors with identical UBVR pulse-counting photometers. Limits of light variations, average colours, number of observations and intervals of phases calculated according to Mathieu et al. (1991) are listed in Table I. Maidanak UBVR-photometry is stored in Tashkent Astronomical Institute Bank Data: (Shevchenko V.S., Astronomical Institute of Acad. Sci. RUz., Astronomicheskaya str. 33, Tashkent, 700052 CIS (S.U.)), and are available.

The folded light curves of GW Ori based on Maidanak photoelectric observations, Bouvier and Bertout's observations and some other ones are shown in Figure 1. Our phase values obtained at Maidanak are very close to those of Mathieu et al. (1991), ($T_o=2447909$ and $T_o=2447903$, respectively). Algol-like fadings are distinguished near phase 0.00 in spite of significant irregular light variations. There are sufficiently complete observations of two Algol-like minima in 1988 and 1990. They are shown in Figure 2. It is most probable that minima of 1988 and 1990 occurred due to occultation of the T Tauri star GW Ori by a circumstellar formation surrounding the secondary component. This provides an inclination angle of the orbital plane $80°<i<90°$ and the secondary mass $M_2<0.25M_\odot$.

Table I. UBVR data

Year	Epoch 2440000+	Phase	N	V max–min	<U–B>	<B–V>	<V–R>
1987	7031–7133	0.37–0.79	38	9.815–10.058	0.324	0.977	0.955
1988	7392–7549	0.86–0.51	69	9.867–10.310	0.205	1.001	0.967
1989	7767–7887	0.41–0.91	51	9.848–10.026	0.307	1.018	0.950
1990	8135–8279	0.93–0.53	58	9.860–10.119	0.339	1.003	0.946
1991	8489–8589	0.39–0.81	52	9.759– 9.970	0.298	0.982	0.923

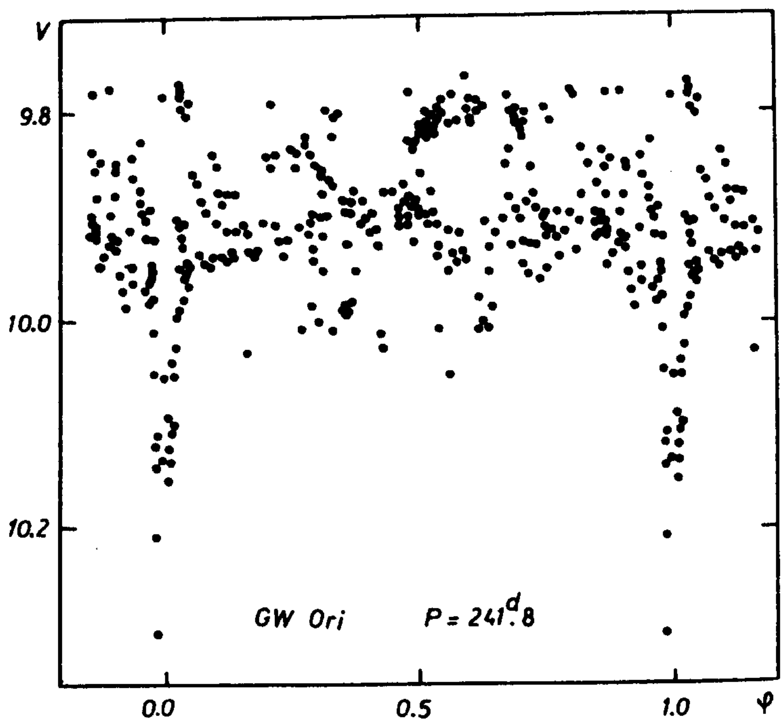

Figure 1. The folded light curve of GW Ori in V-band

To search for a short-period component in the light variability, our observations made in 1987–1991 were analysed by method of digital spectral analysis (Berdnikov et al., 1991; Grankin et al., 1991). But no significant period shorter than 100^d was revealed by this analysis, though the light curves outside eclipses contain waves of different duration. Two power spectra are shown in Figure 3 as a sample. At the same time less reliable periods $1.5 < P_o < 10$ days may be revealed in shorter intervals (< 20 days). So, a similar period

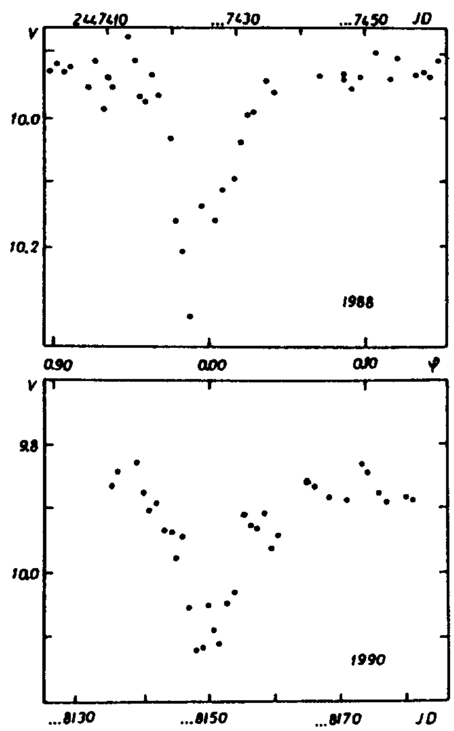

Figure 2. The 1988 and 1990 minima of GW Ori

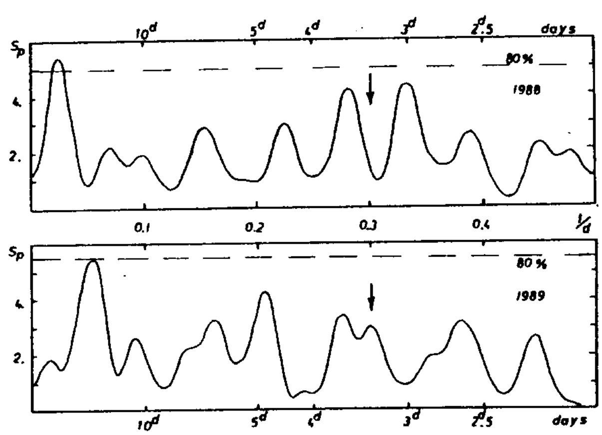

Figure 3. Samples of power spectra for GW Ori. The dashed line indicates 80% confidence interval. The period in the 3–4 day interval (arrows) is absent.

$3.0<P_0<3.8$ days was confirmed by Bouvier and Bertout's (1989) data covering an interval of 13 days.

The circumstellar formation around the low mass secondary component seems to consist of dust and molecular gases having a dimension of $(10-50)\times10^8$km. The masses of the secondary stellar body and its circumstellar formation can be comparable.

We suppose that the next eclipse will take place on 10 September 1992 near zero phase.

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THE EXTREMELY YOUNG CLOSE BINARY SYSTEM HERBIG BE-STAR V628 CAS = MWC 1080

V628 Cas = MWC 1080 is a well-known irregular variable Herbig Be star associated with bright and dark nebulosity. The first detailed description of its spectrum was given by Herbig (1960). He detected many strong FeII emission lines, Balmer series emission lines and strong dark H and K CaII lines which originate in the shell. The Balmer and strong FeII emission lines at 4924 A and 5018 A show deep P Cygni absorption fringes. Later Finkenzeller and Mundt (1984) stated that the spectrum of MWC 1080 showed two strongest narrow Na D_1 D_2 absorptions (at -15 and -45 km/s) and the third wide Na D_1 D_2 component (at -210 km/s) as well as P Cyg profile of Hα line. MWC 1080 was assigned to B8-A2 type (Dibaj, 1969) and B0 (Cohen and Kuhi, 1979). Mass loss from MWC 1080 is of $3\times10^{-6} - 10^{-5}$ $M_\odot$/year. MWC 1080 is an infrared source (Harvey et al., 1979) connected with radio sources (Curiel et al., 1987; Canto et al., 1984).

Shevchenko (1989) suspected a short-period component with periodicity of $\approx 1^d$. Here we present the photometric period of V628 Cas as a close binary system.

Our own observations of V628 Cas have been made at the Mt. Maidanak 60-cm Zeiss reflector with UBVR(I) pulse counting photometer since 1983. The annual limits of light variations, average V light and colours as well as number of observations are listed in Table I. Maidanak UBVR photometry is stored in Tashkent Astronomical Institute Data Bank: (Shevchenko V.S., Astronomical Institute of Acad. Sci. RUz., Astronomicheskaya str. 33, Tashkent, 700052 CIS (S.U.)), and are available. There are 930 UBVR observations during 9 years. Three 100 A/mm spectrograms were obtained in September 1988 using the Byurakan 2.6-m reflector with UAGS spectrograph equipped with an image tube.

To search for a period in light variability our observations made in 1984–1991 were analysed by methods of digital spectral analysis (Grankin et al., 1991). The analysis yields a period of 2.8869 days. Average light curves with the period in V are plotted in Figure 1. The annual average V light level was reduced to the mean <V> level (see Figure 1.). The "normal light" amplitude is $0^m_.16$ V and elements are:

$$C = 2445607.374 + 2.886926\times E, \quad \text{Min II} - \text{Min I} = 0^P_.60.$$

We believe that V628 Cas is a close binary system with 2.8869 orbital period. The asymmetric light curve and different heights of the first and secondary light maxima are testified as elliptical orbit of the system with the eccentricity $e \approx 0.2$–0.5. The moderate amplitude is due to a perceptible inclination angle (i) of the orbital plane. At the same time V628 Cas is an irregular variable $\Delta V \approx 0^m_.3$.

Table I. Photometric data

JD 2400000+	n	V_{max}	V_{min}	<V>	<U−B>	<B−V>	<V−R>
45607–45707	37	11.36	11.73	11.516	0.18	1.38	1.55
45879–46061	81	11.34	11.77	11.564	0.16	1.37	1.58
46253–46399	98	11.29	11.79	11.528	0.20	1.38	1.57
46611–46805	89	11.42	11.78	11.593	0.21	1.37	1.60
46969–47173	83	11.34	11.78	11.584	0.12	1.36	1.56
47313–47543	124	11.38	11.77	11.580	0.10	1.36	1.52
47690–47887	94	11.34	11.75	11.521	0.11	1.36	1.53
48068–48279	110	11.34	11.75	11.556	0.10	1.36	1.53
48438–48586	216	11.14	11.66	11.375	0.18	1.38	1.53

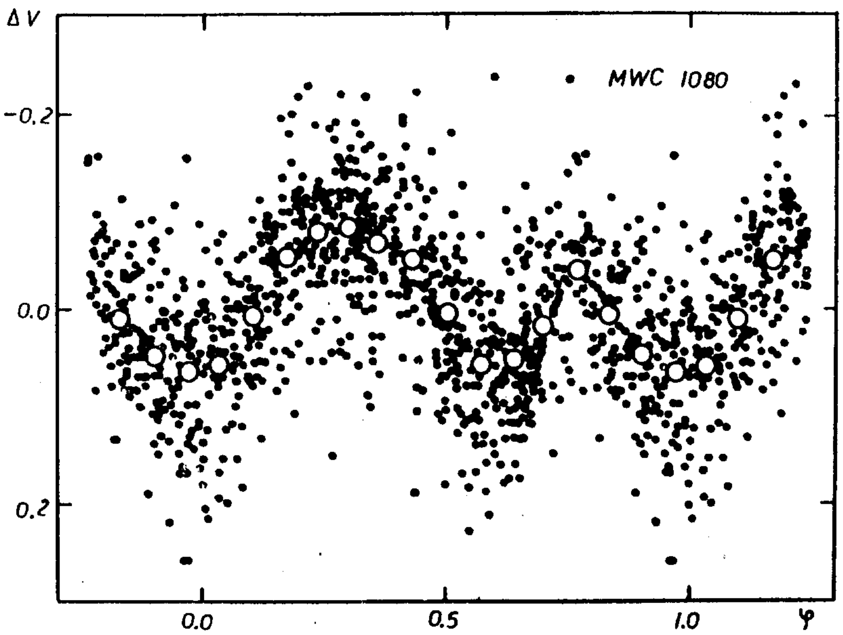

Figure 1. The folded light curve for V628 Cas

Canto et al. (1984) and Yoshida et al. (1991) found the distance of MWC 1080 to be of 2.3-2.5 kpc. The distance 2.2 kpc was obtained using our own UBVR- photometry of 12 faint stars ($13^m_.0$–$15^m_.3$ V) of B0 - A0 types in the close vicinity of MWC 1080. The interstellar extinction near MWC 1080 is $A_V=5^m_.4$ and luminosity of the system is $M_V = -5^m_.5$. The colour diagrams in Figure 2 show strong influence of the hot gas on the luminosity L_o of the system. If the luminosity of the gas shell and that of bright gas flows are equal to $\approx 1/3$ of L_o and the stellar component luminosities ($L_\star$) are approximately identical, $L_\star$ of each component is $M_V = -4^m_.3$ corresponding to a normal B0V type star.

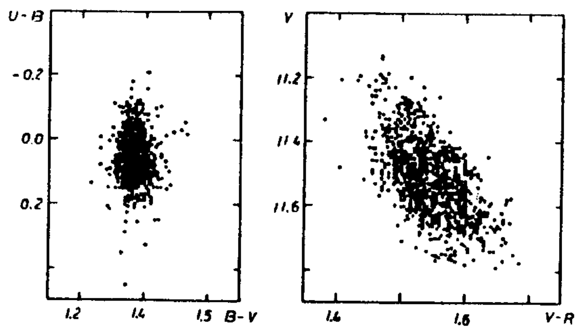

Figure 2. The two-colour diagram (U–B)–(B–V) and colour-magnitude diagram for V628 Cas.

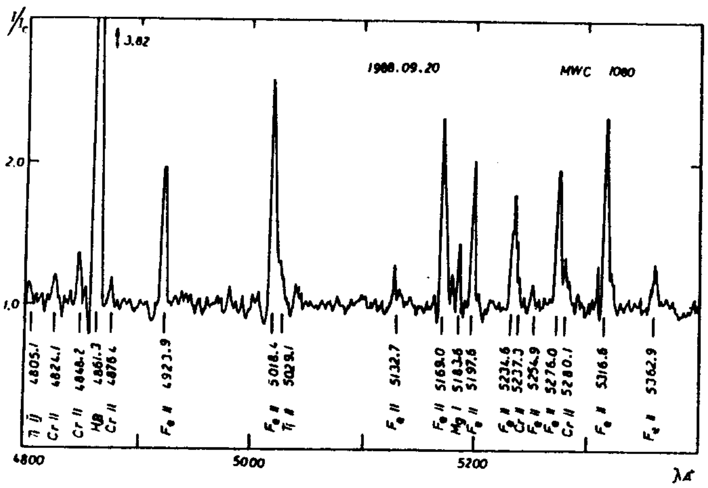

Figure 3. The spectrum fragment of V628 Cas

The Byurakan spectra show many strong ($I/I_c \approx$ 1.5–2) emission lines such as FeII, CrII, TiII (see Figure 3.). Moreover the strongest four lines FeII 4923.9, 5018.4, 5169.0 and 5276, have P Cyg structure similarly to the Balmer emission lines.

The spectrum is very similar to the emission spectrum of V380 Ori. But we failed to find any stellar absorption lines in MWC 1080.

It might be that a closer examination using high dispersion would result in discovering the stellar lines. Preliminary calculations show that these lines must be consistent with axial $v_a sini \approx$ 100–150 km/s and a variable orbital $v_0 sini \approx$ 300–400 km/s.

It is very important to perform such thorough high resolution spectroscopic investigations simultaneously with UBVRI - monitoring of V628 Cas.

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Light curves of UY Cam

While performing a Fourier decomposition of the light curves of the high amplitude δ Scuti stars with a view to describing their morphological characteristics (Antonello et al., 1986), the data we found in the literature for UY Cam proved to be inadequate to perform an accurate analysis.

Discovered by Baker (1937), UY Cam has been observed in the UBV system by Williams (1964) who classified the star as an RRc type variable. These measurements are the most consistent photometric data up to now. The mean B-V = $+0\overset{m}{.}20$ and the colour range $0\overset{m}{.}12$ agree with the spectral classification A3 III - A6 III (Wallerstein, 1958) and no appreciable reddening appears. According to Williams the notable dispersion of points in his light curve may indicate changes from cycle to cycle.

Jones (1966) also obtained a set of UBV photoelectric measurements. Both authors used the star A as comparison (V=$10\overset{m}{.}41$, B-V= $+0\overset{m}{.}58$), given in the finding chart of Baker, which proved to be constant.

An extensive set of visual observations, starting from 1946 up to 1965 was obtained by Beyer (1966). Twenty-one normal epochs of maximum light have been derived from these observations. Using also an epoch derived from the data of Williams, Beyer computed the following ephemeris:

$$\mathrm{Max = hel.\ JD\ 2435565.236} + 0\overset{d}{.}26704234\ n$$

The corresponding O-C residuals show that the period was constant during the eighteen year interval encompassed by these data. According to Beyer the light curve is not stable, in particular its amplitude changes from $0\overset{m}{.}17$ to $0\overset{m}{.}50$.

Since both Williams and Beyer pointed out an instability of the light curve, suspicion arose that UY Cam can pulsate in two or more modes, so it seemed advisable to obtain new light curves. The B and V photoelectric observations reported in this note were obtained using a two beam photometer applied to the one meter Zeiss reflector of the Merate Observatory (Broglia and Conconi, 1985). Because of mechanical limitations of the photometer, star A of Baker's finding chart cannot be used as comparison because it is too close to the variable. Star c was used instead and star A served as the check star. As soon as the observations of the first three nights were reduced, star c appeared to be variable, and from then on UY Cam was compared to SAO 6369. This star proved to be constant; the means of some tens of B and V magnitudes differences between SAO 6369 and A have in fact r.m.s. errors of $0\overset{m}{.}010$. Assuming for A the values V= $10\overset{m}{.}41$, B-V= $+0\overset{m}{.}58$ given by Williams (1964), for SAO 6369 we have: V=$8\overset{m}{.}63$, B-V = $+0\overset{m}{.}68$. In order to get insight into the variation of the star c and try to recover the measurements of UY Cam referred to star c, because we do not dispose moreover of a sufficiently large number of measurements of check star A, an analysis of the $\Delta m = m_c - m_{UY}$ was performed using a period finding technique. It was shown that the star c is a W UMa type variable with a period of 0.76425 days (Broglia and Conconi, submitted to IBVS). Afterwards the light variation of star c, represented by a cosine series, was subtracted from the Δm's of the first three nights and the light curves of UY Cam were derived. These light curves match well with those obtained on the following two nights, while referring UY Cam to SAO 6369. The average deviation of an observation in relation to a Fourier least squares fit of the light curves with harmonic up to the fourth, as it is usual to get a good representation of the light curves for most monoperiodic δ Scuti stars (Antonello et al., 1986), proved indeed to be $0\overset{m}{.}007$.

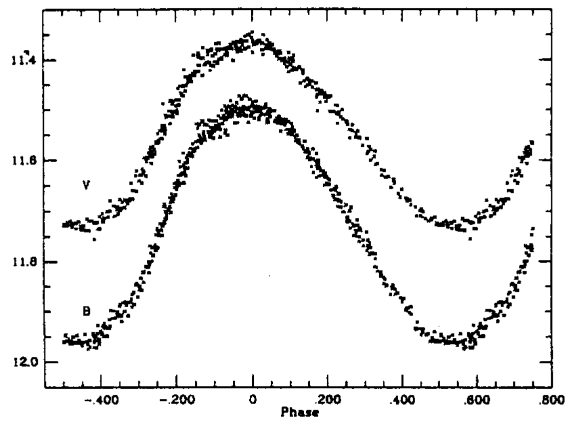

Figure 1

The individual measurements are displayed in Figure 1, and have been submitted to I.A.U. Archives as file number 246E. We have the results:

Max	$V = 11^{m}.365$	$B\text{-}V = +0^{m}.13$
Min	11.730	0.23

The following five instants of maximum light have been derived:

hel.JD	2446170.4948
	6171.5640
	6172.3590
	6173.4302
	6184.3815

Hence we have the improved ephemeris calculated over an 38 year interval:

$$\mathrm{Max} = \mathrm{hel\ JD}\ 2435565.2414 + 0.267042254\, n - 405\ 10^{-13}\, n^2$$
$$\pm\ 12 \qquad\qquad 128 \qquad 35\ \mathrm{m.e.}$$

A second order term in the fitting of the times of maximum light appears to be meaningful because it allows a 2.5 times reduction of the O-C residuals in relation to the linear ephemeris. The measurements given in this note show no evidence for instability in the light curves like those referred to above. According to the Fourier parameters of light curve (Antonello et al., 1986) UY Cam appears to be a high amplitude monoperiodic pulsator of the morphological group A.

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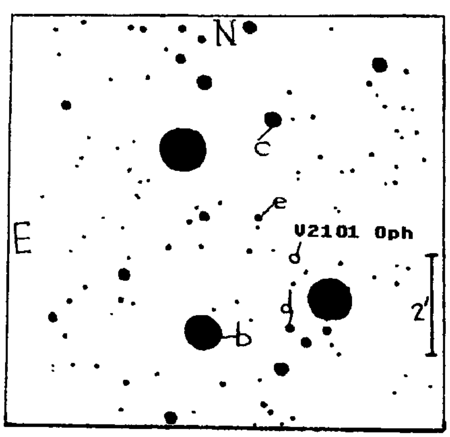
V2101 OPH IS NOT A CATACLYSMIC VARIABLE

The star V2101 Oph, originally discovered by Woods (1926) and reanalyzed by Swope (1932) has been analyzed using photographic plates taken at the Crimean Astronomical Laboratory, between 1960 and 1991, on the 40 cm Astrograph in B light. The data were reduced at the Sternberg Astronomical Institute.

This star was previously classified as a dwarf nova, type U Geminorum (GCVS 4^{th} Edition). After the reduction of data using the Deeming (1975) and Lafler-Kinman (1965) methods for determining the period, a best period of 240 days was found. The light curve of the star folded with the period of $240^{d}$is shown in Figure 3. A better analysis, using windows of data shows increases and decreases of brightness near the star's maximum (Figure 2). A comparison of the POSS blue and red prints (-24 $16^{h}54^{m}$) shows that the star is clearly red, where on the blue print m_B = 17.12. On the POSS (-30 $16^{h}54^{m}$) the data is ambiguous (Samus, private communication); so it is not clear that the star is "bright blue" as stated by Vogt and Bateson (1982). Considering this, and that at the maximum, $m_{pg,R} = 12.5$ (Terzan and Ounnas, 1988) and $m_{pg,B} = 13.33$, we conclude that this star is a red, long period star (type Mira). Independent works have shown that the



a.)

	B
b	12.49
c	14.43
d	15.8
e	16.4

b.)

Figure 1. a.) Finding chart of V2101 Oph, b.) Magnitudes of the comparison stars

Table I. Photographic observations of V2101 Oph

J.D. 24...	B	J.D. 24...	B	J.D. 24...	B
37109.430	14.66	44819.300	16.72	46944.460	17.92
130.350	14.27	820.290	16.72	945.450	<15.5
138.320	13.88	45087.520	15.06	977.350	16.72
139.340	14.27	134.410	14.66	978.370	16.72
144.340	14.27	464.520	<16.7	47264.570	13.88
145.330	14.66	469.520	<16.7	329.410	17.12
40738.500	16.72:	494.430	<17.5	383.290	<16.7
745.440	<16.7	496.420	<16.7	620.560	<16.7
43989.520	16.72	.450	<16.7	626.540	<16.7
992.520	17.12	499.410	<16.7	681.460	<17.1
993.450	16.72	523.380	17.12	682.440	16.72
994.550	<15.5	546.320	<16.7	716.320	14.66
44015.450	17.52	552.300	<15.5	.340	14.57
020.440	<16.7	823.510	13.33	717.350	14.66
023.430	<16.7	.530	13.49	740.340	13.75
028.430	<15.5	824.520	13.33	48028.410	16.29
041.380	<16.7	825.520	13.49	029.430	16.29
406.380	13.88	826.530	13.49	033.450	16.29
409.410	13.88	846.420	14.27	034.460	16.40
410.390	13.88	849.460	13.88	035.410	16.72
430.360	14.66	852.460	14.66	037.390	16.72
435.340	14.86	873.390	17.12	389.500	17.12
438.360	15.06	875.400	<17.1	394.470	16.72
789.360	<15.5	876.360	16.72	418.420	14.86
811.320	<15.5	884.370	17.12	423.410	14.66
812.310	17.52	46204.470	<15.5	425.410	14.66
813.310	17.12	209.460	<16.7	426.410	13.88
815.300	<16.7	256.370	17.12	448.380	13.22
818.310	<16.7	589.420	16.29	454.340	13.75

color variations are not typical of U Gem, that the brightness increase reaches its maximum in B and decreases to R (Yakubov et al., 1992), and that its spectrum is a late type one with strong TiO bands fitting an M5 II–III type (Claudi and Bianchini, 1992) what reinforces our conclusion.

The magnitudes of the comparison stars were obtained by comparison with the standard sequence in the field of V2051 Oph (Meech, 1983) and are listed in Figure 1b. Figure 1a contains the finding chart of V2101 Oph. Table I lists the Julian Dates and the observed B magnitudes.

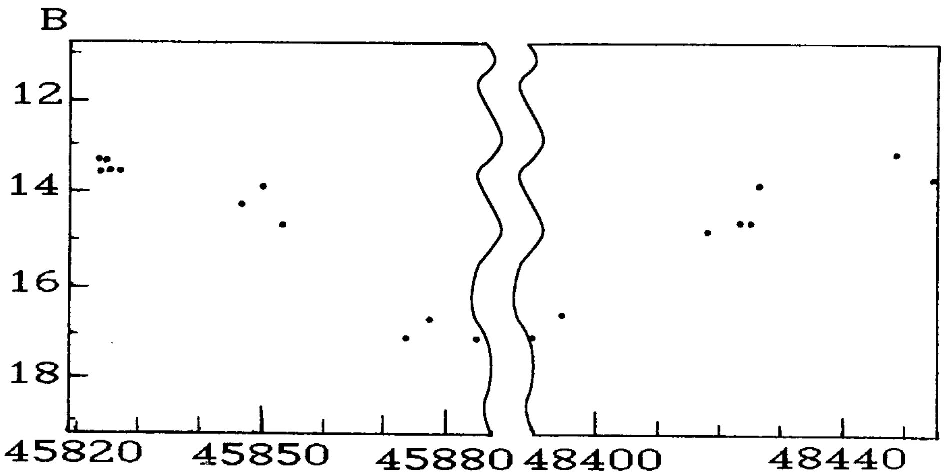


Figure 2. Variation of brightness around a maximum

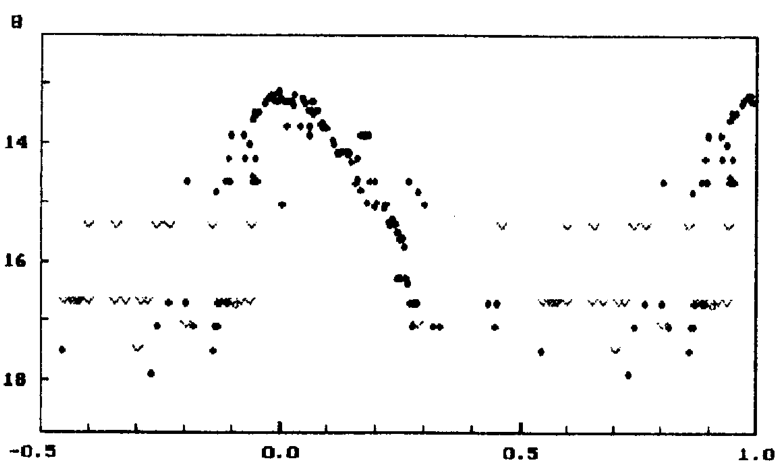


Figure 3. Light curve for P=240$^{d}_{\cdot}$3 with the initial maximum at J.D. 2448450

Besides the data listed in Table I, data from Yakubov et al. (1992) obtained in 1991 were also used in order to find the light curve shown in Figure 3, where the different sets of data are marked with the same symbol.

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DISCOVERY OF RAPID OSCILLATIONS IN THE Ap STAR HD 150562

The cool Ap star HD 150562 was monitored photometrically for 4.67 hr on the night JD 2448411 as part of the *Cape Rapidly Oscillating Ap Star Survey*. Inspection of the real-time data display at the telescope indicated the presence of rapid oscillations with a period P = 10.75 min and amplitude A = 0.75 mmag (Fig. 1). The observations were acquired using the St Andrews Photometer attached to the 1.0-m telescope at the Sutherland site of the South African Astronomical Observatory.

The data were acquired in continuous 10-s integrations through a Johnson B filter with occasional interruptions for sky background measurements. An autoguider was used to track an off-axis guide star thus minimizing the effect of light variations caused by tracking errors in the telescope. The data were corrected for coincidence-counting losses, sky background, extinction and some long-term (P > 0.5 hr) trends caused by sky transparency variations. The data were then binned to 40-s integrations. The resulting instrumental magnitudes were not placed on the standard system.

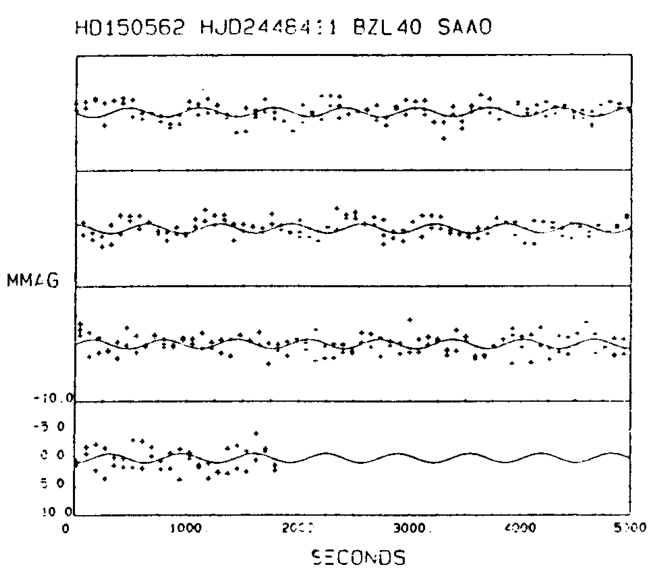

Figure 1

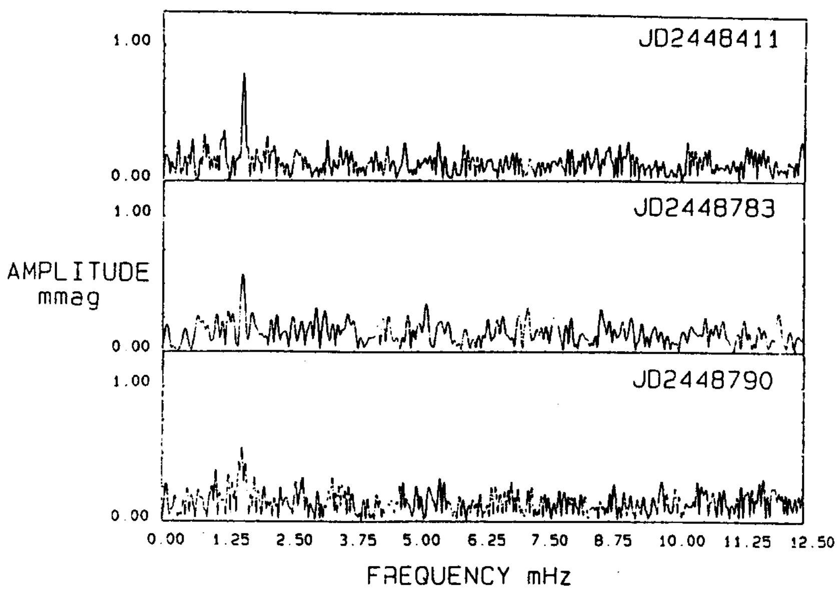

Figure 2

To confirm the presence of rapid oscillations, we observed this star again on nights JD2448427, 8462, 8465, 8723, 8783, 8786, 8790 and 8792. In Figure 2 we show the amplitude spectra acquired on three good nights. The prominent peak is at ν_1 = 1.55 mHz. The solid line in Fig. 1 is a sinusoid of frequency ν_1 = 1.55 mHz, with least-squares-fitted amplitude and phase, which has been plotted to facilitate the reader's perception of the oscillations.

Inspection of all available amplitude spectra suggests that the oscillations in HD 150562 are amplitude modulated. To refine our determination of ν_1 and to search for additional frequencies, we Fourier analyzed the last four nights together. However, the daily aliases are too severe to accomplish either of these goals. The value of ν_1 is ambiguous by 1 cycle day^{-1} in these data; we cannot distinguish between ν_1 = 1.5585 mHz and ν_1 = 1.5470 mHz. Further observations and a detailed frequency analysis of the rapid oscillations of HD 150562 will be presented in a future publication.

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High-speed IR photometry of the roAp star HD134214

Rapidly oscillating Ap stars (roAps) are mostly cool, magnetic ApSrCrEu stars which suffer oscillations with periods of a few minutes and amplitudes of a few mmag in the blue band. The class was first described by Kurtz (1982) and, over the last decade, several searches for new members have been conducted with variable degrees of success (see e.g. Martinez *et al*, 1991). So far, the roAp class is formed by roughly twenty objects with quite significant properties (Kurtz, 1990).

HD134214 is one of the few roAp stars which can be observed from the northern hemisphere, during a substantial period of time (m_v=7.48, α=15.1 h, δ=-13.°78). When it was discovered as a new member of the group, using two-site rapid B band photometry (Kreidl and Kurtz, 1986), HD134214 oscillated with a frequency of 2949.6 μHz and an amplitude of 3.21 mmag. Since then, critical frequency changes of around 0.5 μHz have been detected, as well as large phase shifts (Kreidl, 1992). However, the amplitude has remained almost constant during the last 7 years, with values ranging from 3.2 to 3.5 mmag. These kinds of phenomena had never been observed in any other member of the class.

In recent years, a controversy has been raised concerning the possibility of detecting the oscillations at infrared (IR) wavelengths. In principle, the amplitude should decrease with increasing wavelength by a certain amount (ratios $\Delta B/\Delta J \sim 4$ and $\Delta B/\Delta K \sim 6$ have been proposed: Matthews *et al*, (1990). However, opposite results have been obtained so far. Weiss *et al* (1991), in αCir, and Belmonte *et al* (1991), in 10Aql, have found marginal evidence of amplitude excesses at IR wavelengths, when trying to establish upper limits. On the contrary, Matthews *et al* (1992) always find amplitudes lower than expected in the H, J and K bands. They show that this discrepancy could be explained by the wavelength dependence of limb darkening and its weighting effect on the integrated photometric amplitude of a non-radial mode. To further complicate the situation, new, recent observations on 10Aql do not seem to repeat previous findings (Belmonte *et al*, 1992).

In this paper we report on an effort in the same direction, presenting the results obtained in the roAp HD134214 after nearly 45 hours of rapid IR photometry (J and K bands) performed in April and May 1991, at a good photometric site for the IR. The observations were conducted at the 1.54*m* Carlos Sánchez Telescope (TCS) of the

Teide Observatory (OT) in the canary island of Tenerife (Spain). The instrument was the standard CVF infrared system with a cooled solid state detector. This configuration allowed to measure automatically cycles of 20s integrations on several filters, performing simultaneous sky background corrections. In this particular case, we chose to observe in the J (1240 nm) and K (2200 nm) bands, completing a whole cycle every 53 seconds, adequate for the periods we wanted to investigate (order of 5 min). Weather conditions were excellent during most of the run, as can be seen in Table 1 which gives the journal of the observations. Globally, nearly 45 hours of useful data were obtained, which represents 80% of possible coverage and 26% of the whole duty cycle. Figure 1 shows the light curves, in both filters, obtained for one of the good nights. Direct evidence of oscillations was not found on any night.

Date (1991)	$\int$	t (hours)	K_J	K_K	σ_J (mmag)	σ_K (mmag)
29/4	431	6.82	0.114	0.083	4.4	3.7
30/4	244	3.57	0.090	0.062	2.8	3.7
01/5	421	6.67	0.089	0.079	4.7	4.5
03/5	207	3.28	0.064	0.071	3.5	5.4
04/5	421	6.67	0.104	0.064	6.1	6.8
05/5	466	7.38	0.062	0.048	6.6	9.3
06/5	427	6.76	0.079	0.061	4.6	6.1

Table 1: *Journal of observations. For each date, the table lists: the number of 20 s integrations, the length in hours from the beginning to the end of the run, the extinction coefficient derived for the J and K filters, and the standard deviation of the airmass fit reduction procedure.*

The J and K photometric data series were reduced with a standard astronomical fit to airmass. This procedure yields the residual series, together with the standard deviation of the fit (an indication of the data quality) and the extinction coefficients in the IR bands. On this ocassion, values of K_J=0.086±0.002 *mag per airmass* and K_K=0.067±0.002 *mag per airmass* have been obtained for these coefficients; these are amongst the most accurate ever obtained for OT.

Residual series were analyzed via an iterative sine wave fitting procedure. Little information could be gained from the individual nightly spectra, so that an analysis of a 45 hour long global series was made, with an intrinsic resolution of 1.45 μHz (not enough to study possible frequency shifting). The amplitude spectra obtained are presented in Figure 2.

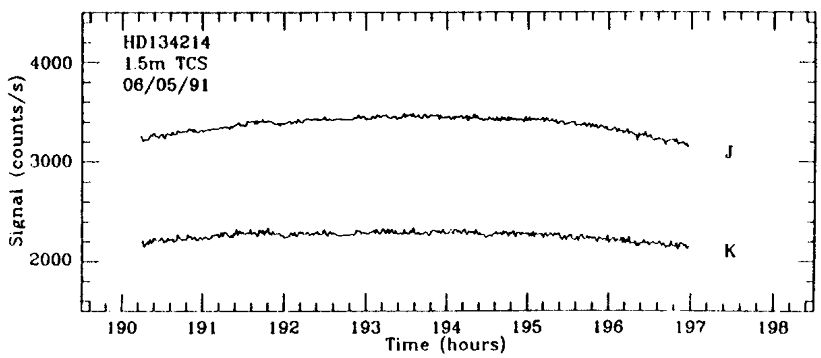

Figure 1: High-speed IR photometry light curves of HD134214 in the J and K bands, for the night of May 6 1991.

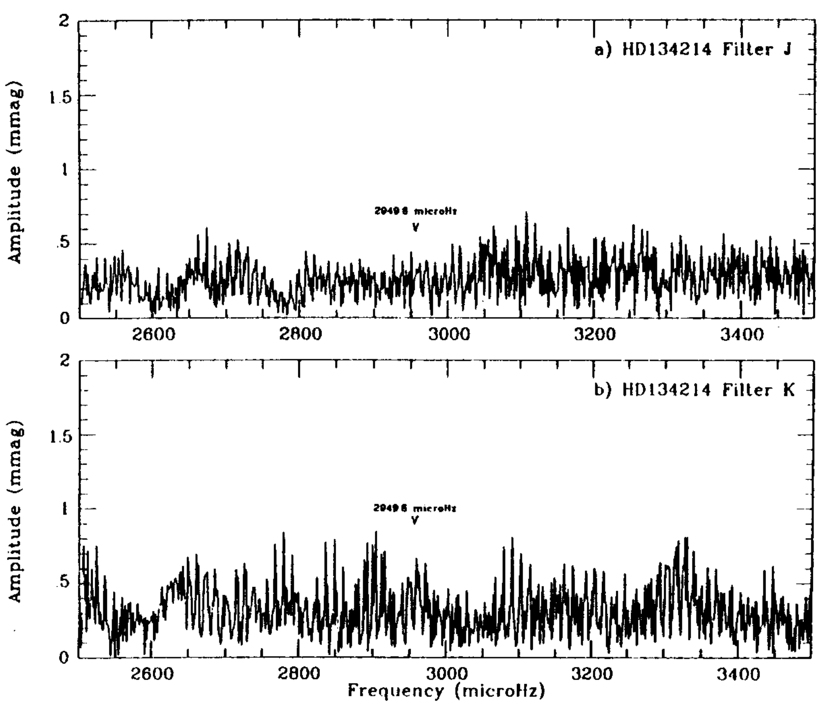

Figure 2: Amplitude spectra of the global 45 hour residual series in the J (a) and K (b) filters. The location of the frequency where oscillations are evident in the blue band is also signaled in the plot.

Despite the low noise level attained at both wavelengths (well below 0.8 mmag), we cannot claim detection of oscillations at the frequency interval (2949-2950 μHz) where peaks are found in other wavelengths. Having in mind a constant amplitude, as suggested by recent observations, for a ΔB$\sim$3.2 mmag, we should have found ΔJ$\sim$0.8 mmag and ΔK$\sim$0.6 mmag. However, as clearly shown in Fig. 2a, an uppermost limit of order 0.5 mmag can be fixed for the amplitude of any possible oscillation in the J band. The evidence is not so clear for the K band, where a peak of 0.65 mmag is located nearby the known oscillation frequency.

In principle, with these results in hand, we feel inclined to support the latest results given by Matthews *et al* on other roAps. However, our previous experience with this kind of observation compels us to be very cautious before supporting the existence of the deep decline in the wavelength dependence of amplitude, at IR bands, on the basis of so little evidence. Besides, the strange behaviour displayed by HD134214 over the last few years still deserves a deep explanation. A multi-site, multi-band, rapid photometry campaign is highly desirable, and would put us in an ideal position to face all the problems stated above.

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**10 Aquilae revisited:
rapid photometry in the IR and visible bands**

The star 10 Aql (HR7167, HD176232) was initially reported as a rapid oscillating Ap (roAp) star by Heller and Kramer (1988). It is one of the two known roAp stars with positive declinations (m_V=5.89, α=19 h, δ=13.°9). The class of roAps is currently formed by cool, magnetic, Ap SrCrEu stars, which undergo oscillations with periods from 4 to 15 minutes and amplitudes of a few millimagnitudes (mmag) in blue light. This group was first described by Kurtz (1982) and several searches for new members have been conducted since then (see e.g. Martinez *et al*, 1991; Nelson and Kreidl, 1992), with over 20 discovered so far. A magnificent review covering all topics on roAp stars can be found in Kurtz (1990).

Over the past few years, a controversy has been produced on the possibility of detection of the oscillations at infrared (IR) wavelengths. According to Matthews *et al* (1990), the amplitude should decrease with increasing wavelength, following a certain criterium. However, quite contradictory results have been obtained so far. Several campaigns have yielded significant, negative results (see e.g. Matthews *et al*, 1992; Belmonte *et al*, 1992). However, excited by the marginal positive detection reported by Weiss *et al* (1991) in α Circini, Belmonte *et al* (1991) conducted a rapid IR photometry search for oscillations in 10 Aql. The outcomes were surprising, since some frequency peaks, just at the limit of credibility, were located in the amplitude spectra, at almost exactly the same frequencies reported by Heller and Kramer (1990) for observations in the blue band. Unfortunately, on that occasion, no simultaneous visible photometry series were available, hence, they were unable to give a correct answer to the problem.

One year later, new observations were undertaken, this time simultaneously in b, y and H bands. The IR observations were made at the 1.54m Carlos Sánchez Telescope (TCS) of the Teide Observatory (OT) on the Island of Tenerife (Canary Islands, Spain). The instrument was a liquid nitrogen cooled photometer with an InSb solid state detector, and a focal plane chopper. This instrumentation allowed to make continuous 10s integrations on the star, performing simultaneous sky background corrections. In this case, we chose to observe in the H filter because, at the time of the observations, the system was showing its best performance at this wavelength. The journal of observations is presented in Table 1. Weather conditions were quite good over most of the observing period. However, some dust was present in the air during 3 nights (June 28, 29 and 30), thus increasing extinction at IR wavelengths, this fact is clearly reflected in Table 1. Globally, some 32 hours of useful data were obtained. The observations in the visible were performed at two places, OT itself and Lowell Observatory (LO). At OT, an on-line small photometer was attached to the TCS, using a blue/red beam splitter, which reflected 5% of the blue light into the photometer aperture. This was the first time this configuration was used. As expected, data quality was not very good and useful data was only obtained for June 27 (σ=7.7 mmag). Simultaneous b and y rapid photometry series were obtained at LO with the 1.1m Hall telescope. Unfortunately, weather conditions were quite humid over most of the run. Only 3 short data series of relatively good quality were obtained for the last 3 nights (see Table 1).

Date (1991)	Σ	t_H (hours)	K_H	σ_H (mmag)	t_{LO} (hours)
25/6	948	4.0	0.095	4.5	
26/6	574	2.6	0.160	2.6	
27/6	1853	6.1	0.110	6.1	5.5*
28/6	1118	3.7	0.237	3.7	
29/6	1928	6.6	0.266	6.6	3.4
30/6	1256	4.1	0.337	4.1	2.9
01/7	1485	5.1	0.044	5.1	2.3

Table 1: *Journal of observations. For each date, the table lists: the number of 10 s integrations, the length in hours from the beginning to the end of the run, the extinction coefficient derived for the H filter, and the standard deviation of the airmass fit reduction procedure. The length in hours of the b and y Lowell series is reported in the last column. (*) This series was obtained at OT.*

The H photometric data series were reduced with a standard astronomical fit to airmass. This procedure yields the final time series, the standard deviation of the fit and the extinction coefficient. In this observing period, a value of K_H=0.18±0.03 *mag per airmass* has been obtained for this coefficient. This number is compatible with the K_J=0.18 *mag per airmass*, found one year before, under similar atmospheric conditions (Belmonte *et al*, 1991). All time series were submitted to a harmonic analysis via an iterative sine wave fitting. Analyses of several series (both IR and visible) were made, with an intrinsic resolution ranging from 1.65 to 3.85 μHz. Figure 1 shows the amplitude spectra yielded by them.

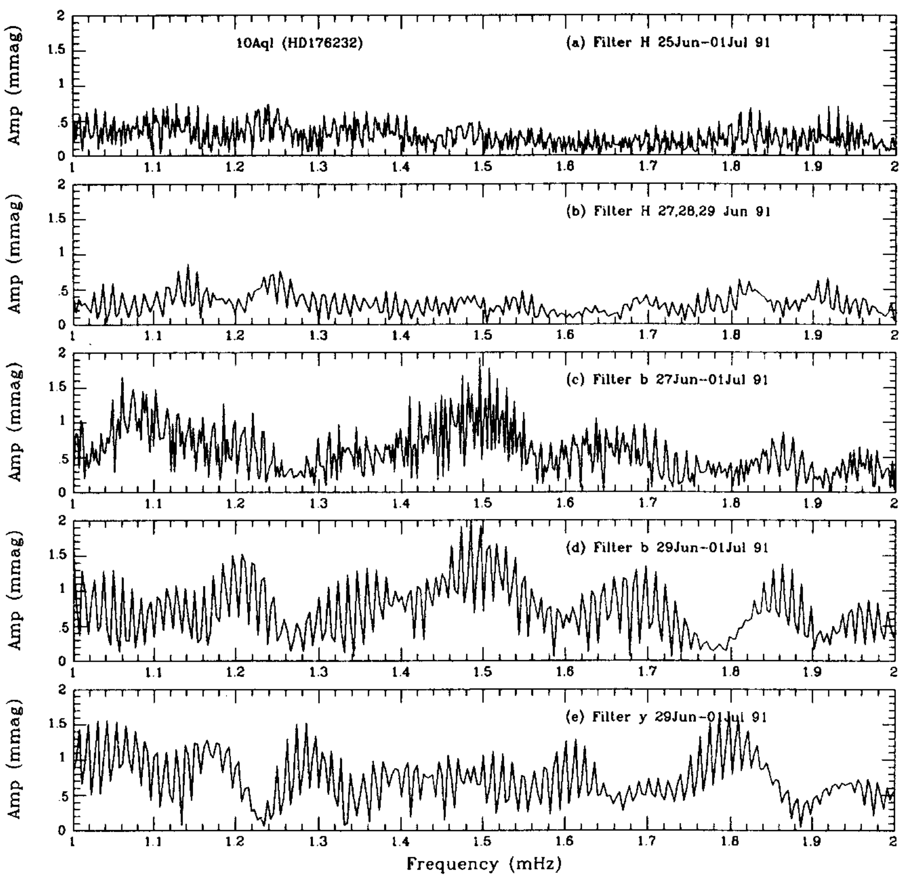

Figure 1: *Amplitude spectra, in the range of interest, of the several rapid photometry time series of the roAp star 10 Aql.* **(a)** *Global OT series in the H filter.* **(b)** *OT 3 best nights series in the H filter.* **(c)** *Global series in the blue, including OT and LO series.* **(d)** *and* **(e)** *Global Lowell series in b and y, respectively. If observable, frequency peaks of oscillation should have been located at 1.26, 1.38 and 1.44 mHz (Heller and Kramer, 1990; Belmonte et al, 1991).*

As already stated, data in the b and y filters were not as good as desired. Consequently, the noise level in their amplitude spectra (see Fig. 1) is high and the evidence of oscillations very poor. Even knowing where to look, it is difficult to define something more than upper limits for the amplitudes. It is pretty obvious that 10 Aql is oscillating with amplitudes in Δb and Δy well below 1 mmag, in agreement with previous reports (Heller and Kramer, 1990).

Regarding the IR time series, we are not able to confirm previous findings reported by Belmonte *et al* (1991). Our new data (see Fig. 1) show similar quality but not the same frequency peaks. Besides, the evidence of a peak of $\Delta H \sim 0.8$ mmag at 1.24 mHz is completely marginal, and should be considered more as an uppermost limit for the amplitude, than the actual amplitude of a frequency peak. Indeed, uppermost limits of $\Delta H \sim 0.5$ mmag might be considered for the other two frequencies reported in the literature, 1.38 and 1.44 mHz. In conclusion, we still do not have a satisfactory explanation for the strange behaviour shown by 10 Aql in July 1990. On the contrary, these new outcomes seem to confirm the theory that roAp infrared amplitudes are extremely low and, consequently, not easily detectable (Matthews et al, 1992).

Disappointingly, 10 Aql is poorly studied, due to its significantly low amplitude. Its frequency spectrum is not yet established, though over 100 hours of photometry gathered by numerous observers and analyzed by Kreidl (unpublished) do confirm the primary 1.26 mHz oscillation. In particular for IR photometry, larger telescopes, better detectors and greater coverage, both spatial and temporal, should be scheduled to reach a good signal-to-noise ratio on this star. Maybe under these conditions, the controversial oscillatory character of 10 Aql can be better understood.

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A NEW W UMA TYPE VARIABLE IN CAMELOPARDALIS

While measuring the high amplitude Delta Scuti star UY Cam in the B and V bands at the Merate Observatory by means of a two beam photometer (Broglia and Conconi, 1992), the stars named c and A in Baker's (1937) finding chart, reproduced in Figure 1, were chosen respectively as comparison and check stars. When the observations were reduced the Δm's between c and A proved to be non constant.

We note that UY Cam was suspected of having variable light curves (Williams, 1964; Beyer, 1966). The number of the measurements of check star A however was not large enough to derive light curves of both c and UY Cam by comparing with star A. The Δm's between c and UY Cam were analysed therefore by means of a period finding technique in order to detect a possible multiple periodicity in UY Cam and to get an insight into the nature of variability of star c. Two sinusoids and their Fourier harmonics up to the fourth one were fitted to the observations by least squares. The period of one sinusoid was kept fixed to the value P=$0^{\mathrm{d}}.26704234$, derived by Beyer (1966) for UY Cam on the basis of a long series of times of maximum. For the other sine curve, P was changed step by step.

Only one period proved to be significant: P=$0^{\mathrm{d}}.76425$. By subtraction of the light changes with P=$0^{\mathrm{d}}.26704234$, the light curves of the new variable were derived. These observations match well with subsequent measurements obtained by assuming the star A as comparison, so that we are confident that the light changes of UY Cam have been fully withdrawn.

The coordinates (2000) of the new variable are: $\alpha = 7^{\mathrm{h}}58^{\mathrm{m}}49^{\mathrm{s}}$, $\delta = +72°46'.3$.

The mean light curves are shown in Figure 2, where the individual plotted points represent average of approximately three measurements in each instance. These observations have been submitted to the I.A.U. Comm. 27 Archives as file number 247E. The new variable shows the typical features of the W UMa type binaries, with partial eclipses.

The following ephemeris was calculated:

Min I = J.D. hel. 2446170.056+$0^{\mathrm{d}}.76425\times$n

Moreover we have the result:

	Max	Min I	Max	Min II
V	$11^{\mathrm{m}}.63$	$11^{\mathrm{m}}.85$	$11^{\mathrm{m}}.64$	$11^{\mathrm{m}}.82$
B–V	+0.38	0.37	0.38	0.37

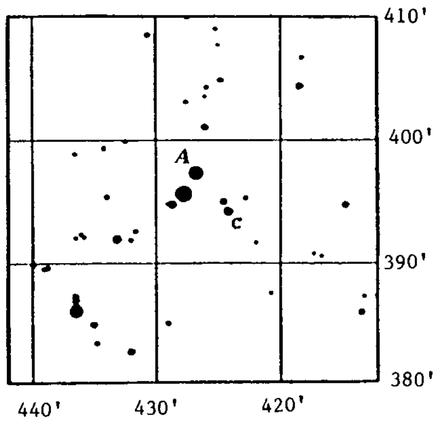

Figure 1

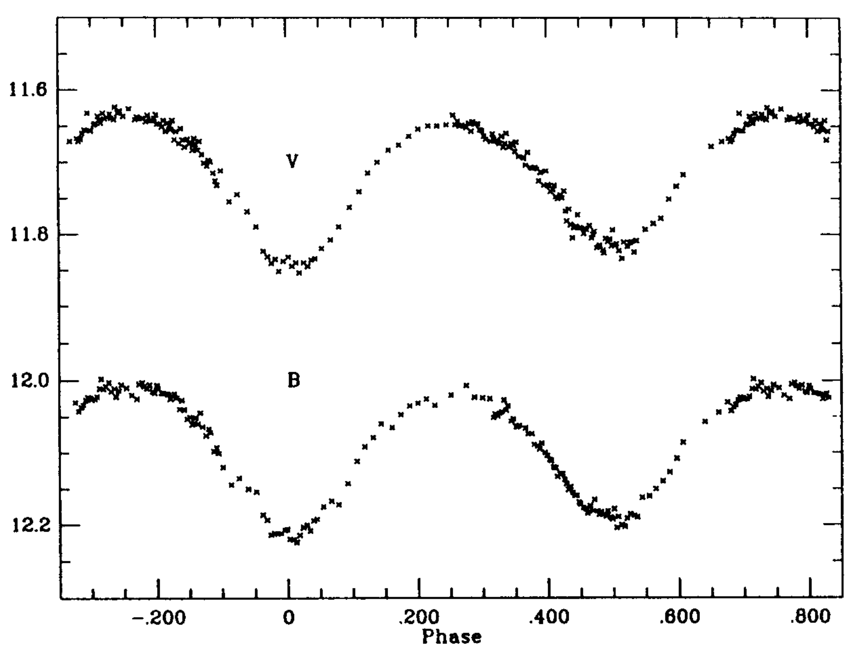

Figure 2

A spectral type F2 is inferred for both components, with no reddening correction.

Photometric solutions were calculated using the code developed by Wilson and Devinney (1971). At first we made several trials with the light curve program. Then the differential correction program was used, in mode 1 option (contact systems). Only the following parameters were adjusted: the inclination i, the luminosities L1 in B and V bands of the primary component and the filling factor F. The other parameters were kept fixed at reasonable values. In particular a bolometric albedo A=0.5 for both components gives a better representation than A=1. The solutions were calculated for several assumed values of mass-ratio q. Both V and B points were used together when deriving the solutions. A strong correlation exists between the adjusted parameters i and F. However the solutions give evidence that the best representation of the light curves can be obtained in the ranges: for q between 0.07 and 0.10, for i from 60 to 63 degrees and with F between 1.4 and 1.6. The results are not conclusive, as the eclipses are shallow and the observations at disposal are quantitatively limited.

When the eclipses are partial and only photometric data are available it is difficult to determine if a system has an A-type or a W-type configuration. Mochnacki (1985) in a review of data for contact binary stars gave some statistical relations regarding these systems. In particular we can see that in the diagrams linking B-V, q, F and the period P, the A-type and the W-type systems occupy well defined and separated regions. The values we have calculated for the new variable suggest that this binary is an A-type system.

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UBVR PHOTOMETRY OF THE FAINT ECLIPSING BINARY HS PERSEI

The eclipsing binary HS Per (= S3892; m = 13.0−15.9 pg) was discovered to be a variable by Götz (1956). The period of the system was uncertain. The star is of A0II-III type (Halbedel, 1984). It is a probable member of the Perseus spiral arm (Zakirov, 1990).

HS Per was observed with the 60 cm telescope during 1988/90 on Mt. Maidanak in the South of Uzbekistan. As a comparison the star BD +56°369 (V = $9^m.867$; U−B = $+0^m.04$; B−V = $0^m.482$; V−R = $0^m.512$) was chosen (denoted with s in Figure 1). The control star (V = $10^m.849$; U−B = $-0^m.295$; B−V=$0^m.070$; V−R = $0^m.088$) is shown in Figure 1 as star c. 184 measurements in U, 399 in B, 402 in V, 379 in R were carried out. According to our estimation the probable error of a single observation of HS Per is $0^m.015$ in V; for U−B = $0^m.020$; for B−V = $0^m.015$ and for V−R = $0^m.025$ at the maximum. They are about twice more at the primary minimum.

The results of our observations are presented in Figure 2 as light and color curves. We have calculated the following ephemeris, using both our and Götz's data of the minima too.

Min I = JDH 2447448.267 + $2^d.836782 \times E$

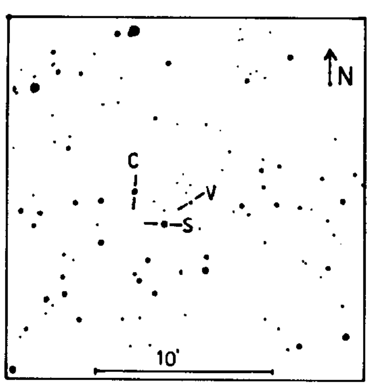

Figure 1. Finding chart of HS Persei

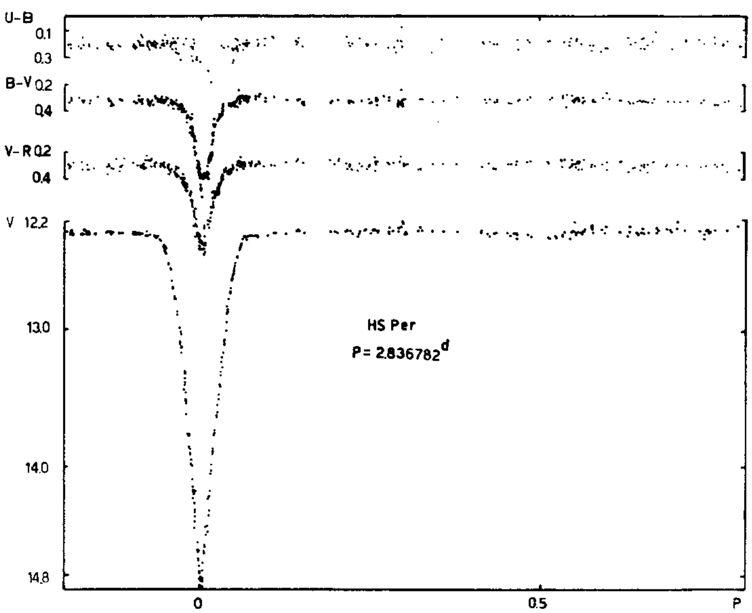

Figure 2. Light and colour curves of HS Per

The photometric characteristics are given in Table I.

Table I.

	V	U–B	B–V	V–R
Max	12.28	0.18	0.32	0.28
MinI	14.88	0.35	0.87	0.93
MinII	12.32	0.18	0.30	0.23

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THE PHOTOMETRIC RANGE OF EX LUPI

EX Lupi is the prototype star of the class of eruptive pre-main sequence variables called EXors. Although its declination (–40°) made it a difficult object for northern observers in the past, that problem has been alleviated in recent years, and there is much information on the star that has been collected from southern sites. However, no recent maxima have been reported, and so there is interest in upgrading the photometric history of EX Lupi for those earlier times when it was active.

McLaughlin (1946) published a summary of his investigation of the star's brightness on Harvard plates obtained between about 1893 and 1941. During most of this time EX Lup remained near minimum light, but on 5 occasions rose approximately 2 magnitudes in brightness to "nova-like maxima". These were spaced at intervals of 4 to 13 years. The photographic magnitudes of EX Lup were referred to a sequence of nearby stars whose identifications and adopted magnitudes are tabulated by McLaughlin.

An extensive series of visual estimates made by A.F. Jones between 1954 and 1956 were published by Bateson and Jones (1957). The most notable event during this time was a bright maximum in late 1955, followed by a weaker secondary brightening; the entire episode lasted about 2 years. (The Jones–Bateson observations are shown as a light curve in Fig. 14, Herbig 1977.) These visual observations were based on magnitudes estimated by Bateson for a set of nearby stars, most of them common to the sequence of McLaughlin.

The purpose of this note is to place these two sets of observations of EX Lup on a modern photometric system so that the range and behavior of EX Lup can be properly compared to those of other EXors.

Modern BV magnitudes were measured for the comparison stars of Bateson and Jones on CCD frames obtained on 15 September 1989 by one of us (N.S.) with the 0.9-m telescope of the Cerro Tololo Inter-American Observatory. The photometric solution was based on 26 of the E-region standards published by Graham (1982) and by Menzies, Banfield and Lang (1980); the scatter about the fit was 0.02 mag. in both B and V, but the magnitudes of the very brightest stars could be in error by as much as 0.04 mag. on account of shutter errors. The results are given in Table 1, where the stars are identified by the letter designations of McLaughlin (1946) or Bateson and Jones (1957).

Table 1
Magnitudes of Comparison Stars for EX Lupi

Star	B	V	B–V	Ptg.mag.	Vis.mag.
W	8.21	8.05	+0.16	—	8.4
X	8.56	7.94	0.62	—	8.9
Y	9.56	9.01	0.55	—	9.8
a	10.31	10.02	0.29	10.9	10.6
c	10.95	10.30	0.65	11.4	11.3
d	10.70	10.14	0.56	11.4	11.5
b	10.66	9.95	0.71	11.4	11.7
f	11.14	9.81	1.33	12.3	12.2
e	11.80	11.26	0.54	12.2	12.4
g	12.06	11.35	0.71	12.4	12.6
i	12.26	11.48	0.78	12.8	13.0
k	12.67	11.69	0.98	13.1	13.3
u	12.35	10.44	1.91	—	13.5
l	13.23	12.43	0.80	13.3	13.8
m	—	—	—	14.1	—
n	—	—	—	14.2	—
EX Lup	12.60	11.89	0.71		

The regression of B on McLaughlin's "ptg.mag." is acceptably linear:

$$B = 1.1678\ (pg) - 2.504 \qquad (1)$$

If it is used to convert McLaughlin's range for EX Lup, 11.4–13.9, in B that range becomes 10.8–13.7, the minimum being an extrapolation of 0.5 mag. beyond the faintest star measured in Table 1. Similarly,

$$V = 0.8106\ (vis) + 1.027 \qquad (2)$$

so that the Bateson–Jones range of 8.7–14.0 becomes 8.1–12.4 in V. The star *f* has been omitted in calculating both the above relationships; it seems to be about 1 mag. brighter in both B and V than one would have expected from the photographic and visual estimates.

These corrected ranges indicate that the B–V color of EX Lup at minimum light is about +1.3. This is not unreasonable: observations by Bastian and Mundt (1979) and by Mundt and Bastian (1980) on 5 nights in 1977 and 1979 gave a mean B–V of +1.11 at a mean B of 14.31. However, their mean V (13.20) is fainter than the corrected Bateson–Jones minimum magnitude of 12.4, and their mean photoelectric B is fainter than than McLaughlin's corrected minimum of 13.7.

Most intrinsic variables become bluer as they brighten, and indeed the single spectroscopic observation of EX Lup when bright (Herbig 1950) shows that the star became much hotter. Therefore a value of B–V = +2.8 for EX Lup at maximum light, from the corrected ranges, is not reasonable at all. The explanation must be that the 1955–56 maximum observed by Bateson and

Jones was 2–3 magnitudes brighter than any of the brightness peaks reported by McLaughlin. A discrepancy in this sense is understandable since the visual coverage of EX Lup at the 1955 maximum was much more complete than was possible for the Harvard plate series: the observations by Jones were often spaced one or several days apart, while gaps of several hundred days are apparent in McLaughlin's light curve. For that reason a V range of 8.1–13.2 is to be preferred to the B value.

A reason for this investigation was to determine the photometric range of EX Lup, which with that of PV Cep seemed to be the largest among the known EXors (Herbig 1989). Despite all the foregoing adjustments, the corrected V range of 5.1 mag. remains nearly the same as the original Bateson–Jones value of 5.3 mag.

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ON SEVERAL VARIABLE STARS IN THE FIELD OF M33

Having met some difficulties in locating variables discovered by Romano (1978), we decided to remeasure co-ordinates of these stars. The measurements, carried out by V. P. Goranskij by means of an "ASCORECORD" machine, have led to the following results (equinox 1950.0, epoch 1990.05, accuracy about 0$''$.5 in both co-ordinates):

Table I.

GCVS	GR	R.A.	Decl.
AI Psc	282	$1^h26^m27^s.78$	$+32°27'46''.6$
AK Psc	283	1 26 39.35	+28 56 57.6
AL Psc	284	1 27 37.52	+29 43 16.4
AM Psc	285	1 28 02.60	+31 23 21.4
TT Tri	286	1 29 11.54	+29 33 58.9
TU Tri	287	1 36 24.68	+31 09 05.1
TV Tri	288	1 30 20.83	+32 20 15.9
TW Tri	292	1 33 46.41	+31 45 19.3
	289	1 30 34.72	+32 12 14.4
	291	1 32 43.75	+31 15 29.4

Thus, the co-ordinates published by Romano for GR 283 are wrong by 1°in δ , and those for GR 287 - by almost 7^min α . As a result, the discovery of a new variable, in fact identical with GR 287, was announced by Sharov (1991). Note that the finding chart for TU Tri = GR 287 published by Khruzina and Shugarov (1991) is wrong, again because of their attempt to find the star at the published position. Our identification of TU Tri is quite sure, though a bright star in the field is missing in the chart by Romano (1978).

AL Psc = GR 284 was attributed by Romano (1978) to RR Lyrae stars; he indicated the range $15^m.3$ - $16^m.8$ pg.

One of us (A. S. Sh.) has estimated the brightness of AL Psc on 273 B plates taken with the 50 cm Maksutov camera of the Sternberg Institute Crimean Laboratory (J.D. 2437556 - 2448573). Figure 1 shows the finding chart with comparison stars indicated; their B magnitudes (a = 15.15, b = 16.05, c = 16.60, d = 17.58) rely upon the photoelectric standard (Sandage and Johnson, 1974).

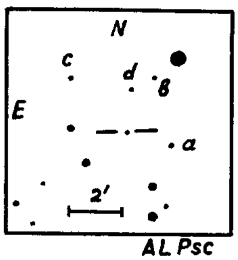

Figure 1. Finding chart of AL Psc

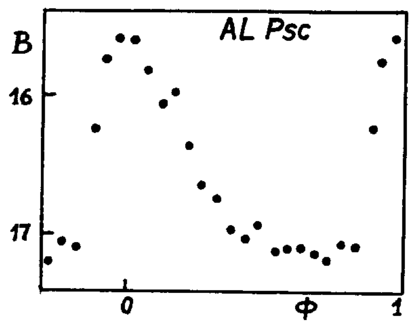

Figure 2. Light curve of AL Psc

We have determined the period of AL Psc using a computer program (Lafler - Kinman algorithm) written by S. Yu. Shugarov. The star is really an RR Lyrae variable (subtype ab) with the following light elements:

Max = 2448524.12 + $0^{\rm d}.456782 \times$E,

the period being apparently constant during the whole time interval covered with our observations. The range is $15^{\rm m}.6$ - $17^{\rm m}.1$B, M–m = $0^{\rm P}.25$. The mean light curve is shown in Figure 2.

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Photometric orbit of the triple system DI Pegasi

The Algol-type eclipsing binary DI Peg is a relatively well observed system. Rucinski (1967) was the first who pointed out that the light curve solution of this close binary needs a relatively large amount of third light (24 % of total luminosity), therefore DI Peg belongs to a triple system. Recently, Lu (1992) presented detailed spectroscopic and photometric analysis of the system and confirmed the existence of the third body from cross-correlation spectra. He also noted that light time effect may be present in the *O-C* diagram.

The aim of the present study was to estimate the parameters of the absolute orbit of the close pair around the centre of mass of the triple system from the *O-C* diagram. Only the times of minima obtained from photoelectric photometry were used (for the list of references, see Lu (1992)). The ephemeris derived by Lu (1992) was adopted:

$$\text{Min I HJD} = 24\ 25918.3597 + 0^d.71181663\ E \qquad (1)$$

A Keplerian orbit was assumed for the wide system. The orbital equations were fitted to the *O-C* diagram (see e.g. Mayer, 1990) with the method of least squares. Note that the dynamical perturbation discussed by Mayer (1990) is negligible in this case because of the long third-body period. The results of the orbital solution are summarized in Table I. The given parameters are the projected semi-major axis, the eccentricity, the longitude of the periastron, the time of periastron passage, the orbital period and the mass function, respectively.

Table I

Orbital elements of the triple system DI Peg

$a \sin i$ (10^6 km)	115	± 31
e	0.66	± 0.2
ω (rad)	2.5	± 0.4
τ (JD)	2440612	± 400
P_{orb} (days)	8070	± 500
$f(m_2)$ ($M_\odot$)	0.001	± 0.001

Fig.1. shows the *O-C* diagram with the fitted curve (top panel) and the calculated orbital radial velocities of the close pair around the common centre (bottom panel).

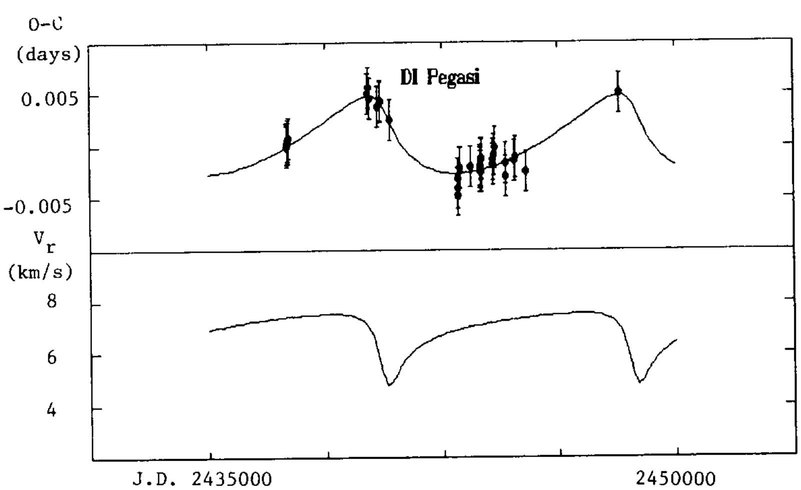

Figure 1

O-C diagram and the fitted orbital curve

Since the 3rd star is roughly as luminous as the components of the close pair, the mass of the visual companion must be close to 1 $M_\odot$ if it is a main-sequence star (the masses in the eclipsing pair are 1.2 and 0.7 $M_\odot$, (Lu,1992)). This means that the inclination of the wide orbit should be $12° \pm 2°$, which gives about 10 AU as the absolute value of the semi-major axis of the relative orbit of the close pair and the 3rd body.

The orbital parameters derived here are quite uncertain, because of the shortness of the observed time interval. Further observations may lead to more precise and complete analysis of this system.

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B and V photometry and the ephemeris of the W-UMa type star RS Serpentis

RS Ser (HV 3073, Sp=F8, V=10.8) with coordinates α_{1950} $18^h14^m29^s$ δ_{1950} $-13°04'.7$ is listed in the GCVS (Kholopov *et al.*, 1985) as a W-UMa type star with a 0.598140369 day period. According to the Rocznik Astronomiczny (Rudnicki, 1990), the star was not the subject of a published investigation since 1954.

From 23 visually determined minima collected by GEOS observers (1982-1990) and from 3 minima taken from the literature (1915-1954), Walas (1991) derived the following ephemeris :

$$\text{Min I} \quad JJ_{Hel} \quad \begin{matrix} 2447355.4509 \\ \pm 16 \end{matrix} + \begin{matrix} 0.5981434 \\ \pm 2 \end{matrix} \qquad (1)$$

(95% of level confidence)

This paper reports new photoelectric measurements obtained by M. Dumont, E. Joffrin, A. Kucinskas, J. Remis and T. Vezauskas with the 76-cm cassegrain telescope and the Geneva photometer, during a run organized by the Palais de la Découverte.

The B and the V filter values of the Geneva system and the B-V ones have been converted into the Johnson and Morgan system using the formula suggested by Meylan (1981). The correlation to standard was ensured by frequent observations of standard stars selected from the Geneva catalogue which were used to compute the first and second order atmospheric coefficients for each night. The complete method of reduction is described by Dumont (1983).

Although the relative accuracy obtained with the standards photometry method is rather low compared with the differential one, it allows more measurements on the variable stars and computation of the B and V magnitudes from the same set of standards. The observations were carried out during 5 nights between August 9 and August 18, 1991. All the observations are listed in Table 1.

For all the observations, the air-mass was larger than 2, which is an unavoidable consequence of the southern declination of RS Ser. Because of that, there are only 2 decimals in the listed V values. Despite the fact that the air-masses were so high, our results show a fair degree of consistency, which reflects the quality of this high-alpine site.

Table 1

V and B-V measurements of RS Ser

JD (Hel) +2440000	V	B-V	Air-Mass	JD (Hel) +2440000	V	B-V	Air-Mass
48478.4206	11.18	0.70	2.17	48484.4448	11.68	0.74	2.65
48478.4226	11.20	0.71	2.19	48484.4462	11.69	0.74	2.68
48478.4265	11.23	0.71	2.22	48484.4476	11.68	0.72	2.70
48478.4289	11.25	0.72	2.23	48484.4490	11.68	0.74	2.73
48478.4310	11.26	0.72	2.25	48484.4524	11.62	0.75	2.80
48478.4348	11.31	0.72	2.29	48484.4538	11.59	0.73	2.83
48478.4362	11.32	0.71	2.31	48484.4552	11.57	0.74	2.86
48478.4390	11.35	0.71	2.33	48484.4566	11.56	0.75	2.89
48478.4417	11.40	0.73	2.37	48487.4335	11.68	0.68	2.60
48478.4438	11.41	0.71	2.40	48487.4355	11.67	0.69	2.64
48478.4459	11.43	0.70	2.42	48487.4369	11.68	0.72	2.66
48478.4501	11.48	0.68	2.48	48487.4383	11.67	0.72	2.69
48478.4522	11.52	0.70	2.51	48487.4418	11.65	0.71	2.75
48478.4556	11.53	0.69	2.55	48487.4432	11.61	0.71	2.78
48478.4605	11.65	0.69	2.63	48487.4446	11.57	0.75	2.81
48478.4626	11.69	0.69	2.66	48487.4480	11.51	0.74	2.89
48478.4653	11.67	0.69	2.71	48487.4501	11.47	0.76	2.94
48478.4674	11.65	0.76	2.75	48487.4515	11.46	0.75	2.97
48478.4723	11.58	0.74	2.86	48487.4557	11.39	0.74	3.08
48478.4744	11.[illegible]5	0.70	2.92	48487.4571	11.37	0.72	3.12
48478.4765	11.53	0.71	2.97	48487.4585	11.35	0.71	3.16
48478.4813	11.46	0.73	3.09	48487.4598	11.34	0.72	3.20
48478.4841	11.48	0.69	3.16	48487.4633	11.27	0.73	3.31
48479.3813	11.58	0.79	2.00	48487.4647	11.24	0.72	3.35
48479.3837	11.54	0.80	2.01	48487.4661	11.24	0.72	3.40
48479.3861	11.49	0.81	2.01	48487.4675	11.24	0.72	3.45
48482.3891	11.21	0.78	2.10	48487.4710	11.14	0.74	3.58
48484.4344	11.60	0.75	2.49	48487.4723	11.12	0.74	3.64
48484.4358	11.61	0.73	2.51	48487.4737	11.11	0.72	3.70
48484.4372	11.61	0.74	2.53	48487.4751	11.13	0.70	3.76
48484.4385	11.64	0.72	2.55				

The V-Phase diagram in Figure 1 shows that only the secondary eclipse has been covered. The mean B-V index is equal to 0.72.

Two secondary eclipses have been observed, and a part of the ascending branch for the primary one. The method of Kwee and Van Woerden (1956) for computing the epochs of minima of eclipsing variables was applied using phase intervals of 0.425 to 0.575 (secondary eclipse). Table 2 shows the photoelectric O-C's referring to the revised ephemeris (1).

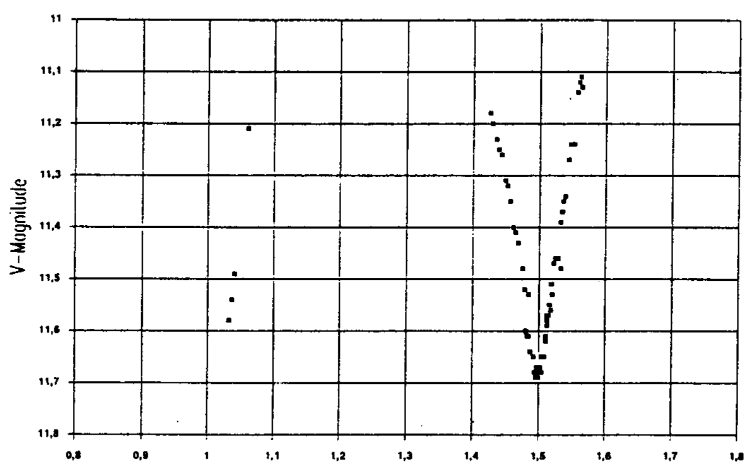

Fig-1 : V-Phase diagram of RS Ser according to ephemeris (1)

An analysis of these data shows that the light parameters mentioned for this star in the last edition of GCVS (Kholopov *et al.*, 1985) are erroneous. As was suggested in a GEOS Circular (Walas, 1991), the minima are deeper than previously stated. The net difference of about 0.1 magnitude noticed by all the visual observers leads to the following light parameters for the two eclipses :

<u>Min I</u> : 11.8 V ? (GCVS 85 : 11.5 V)
<u>Min II</u>: 11.69 ± 0.01 (V) (GCVS 85 : 11.4 V)
12.40 ± 0.02 (B)

Table 2

Photoelectric times of minima

Date	Hel. Julian Day	O-C(1)
09.08.1991	24448478.4649	-0.0002
15.08.1991	24448484.4441	-0.0025

The large eclipse depth suspected from the slope of the ascending and descending branches (near 0.8 magnitude if the star was an EW-type), the duration of the observed eclipse, the net difference between the primary and the secondary ones, make us doubt about the EW nature of RS Ser. We tend to believe that RS Ser may be an EA or an EB-type star.

RS Ser deserves further attention. A complete light curve, based on differential data obtained at an appropriately located site, will allow a more accurate determination of the light elements and the consequent computation of a synthetic solution for the system.

These efforts are planned at GEOS in the next months.

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A NEWLY DISCOVERED ECLIPSING VARIABLE IN THE SW URSAE MAJORIS FIELD

A new eclipsing variable star has been discovered by the authors in the field of the dwarf nova SW UMa during an observational program to collect data on superhump phenomena. Details of the instrumentation and filters may be found in (DeYoung, Schmidt, and Gritz 1991). The I band filter was used for 1199 images, the R band filter was used for 66 images, and a V filter was used for 67 images. Observations were taken on eleven nights from Julian Date 2448705.53823 (March 24, 1992 UT) through 2448762.61821 (May 20, 1992 UT).

The DAOPHOT photometry package, (Stetson 1987), was used in synthetic aperture mode, giving magnitudes of all of the brightest stars in the CCD field. The new star was discovered on the first night by intercomparing all of the stars in the CCD field of view. A search of the *General Catalogue of Variable Stars* (1985), *The New Catalogue of Suspected Variable Stars* (1982), and the various *Information Bulletin on Variable Stars* issues published since 1980 revealed no object corresponding with the new variable. The method of Kwee and van Woerden (1956) was used to determine the heliocentric times of well observed minima (see Table 1). Using the three well-observed times of primary minima in a linear least squares fit gives the following preliminary ephemeris:

$$\text{JD Hel. Min. I} = \underset{\pm .0006}{2448706.7253} + \underset{\pm .000007}{0.358162} * E \qquad (1)$$

The following data were found in the *Space Telescope Guide Star Catalog* (CD ROM Version 1 issued on 1 June 1989) on the new eclipsing variable.

Right Ascension (2000.0)	Declination (2000.0)	m_v
$08^h\ 36^m\ 27.2^s$	$+53^\circ\ 34'\ 40''$	12.4

The general shape of the light curve indicates a borderline semi-detached/contact type binary system. Preliminary fits to the light curve using the GDDSYN software (Hendry and Mochnacki 1992), and the May 1992 revision of the Wilson-Devinney method (Wilson and Devinney 1979) and (Wilson 1979, 1990, 1992) indicate an inclination of 56.5 degrees. The observed instrumental amplitude of primary minimum is 0.2 in the instrumental V, while 0.15 is indicated for the secondary minimum. Figure 1 shows the instrumental differential I-band magnitudes versus phase computed using Equation 1. Figure 2 is an I-band image finder chart for the new variable. Table 1 gives the times of both primary and secondary minima observed during this study reduced to Equation 1.

In the instrumental I band evidence for variation from cycle to cycle is indicated on the maximum occurring at phase 0.75. Secondary minimum is slightly skewed to approximately phase 0.513, or 0.0046 days late, and is caused by the shape changes in the obviously variable light following maximum. The amplitude in the instrumental I band is 0.18 magnitude for primary and 0.14 magnitude for the secondary minimum.

TABLE 1. Times of primary and secondary minima.

CYCLE	HJD	MEAN ERROR (DAYS)	O-C (CYCLES)	O-C (Days)
-0.5	2448706.5403	±0.0006	-0.0165	-0.0059
0.0	2448706.7259	±0.0005	+0.0017	+0.0006
11.0	2448710.6645	±0.0005	-0.0017	-0.0006
19.5	2448713.7062	±0.0009	-0.0092	-0.0033
156.0	2448762.5986	±0.0011	+0.0000	+0.0000

$$\text{Min. I (HJD)} = 2448706.7253 + 0.358162 * E$$

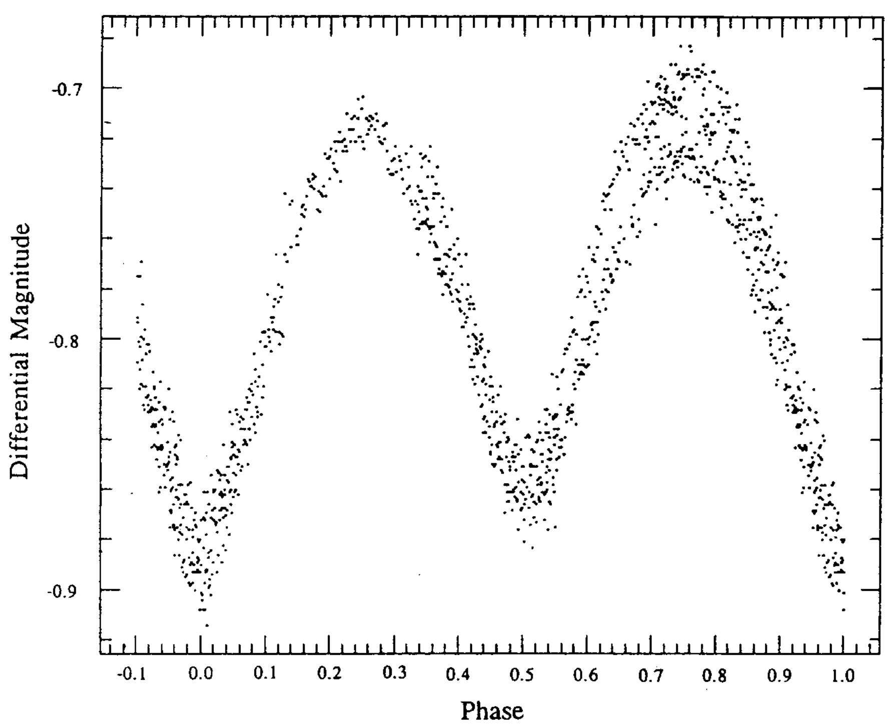

Figure 1. The instrumental I band light curve.

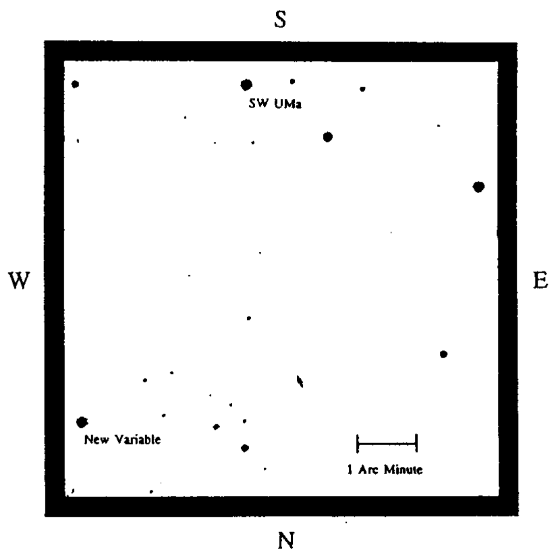

Figure 2. An I band finder chart.

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NEW PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARIES

We continue our program of monitoring eclipsing binaries following our previous publication by Keskin & Pohl (1989). All minima listed in the present paper were obtained at the Nürnberg Observatory (Germany), the Ege University Observatory Izmir (Turkey) or the private Observatory of Rainer Gröbel at Eckental (Germany) during the years 1989 to 1991. Minima times were determined from photoelectric measured light curves taken at the 0.34 m Cassegrain telescope at Nürnberg, the 0.20 m Newton telescope at Eckental or the 0.48 m Cassegrain telescope at Izmir. All telescopes are equipped with a 1P21 phototube.
For each binary in the table we give the heliocentric times of the observed minima, O-C values, the used type of filters in the UBV system, the observers, the instrument and a remark refering to secondary minima. For comparison we calculate two different O-C values. O-C (I) refers to the elements given in the 4th edition of the General Catalogue of Variable Stars (Moscow, 1985 or 1987), O-C (II) to SAC 63 (Krakow, 1992). The following abbreviations belong to the observers:

Bk = B. Kilinç	Ho = M. Hofmann	Sn = S. Evren
Ca = C. Akan	Ib = C. Ibanoglu	Sr = C. Sezer
Er = A. Erdem	Ld = Ö.L. Degirmenci	Tn = Z. Tunca
Gl = Ö. Gülmen	Ls = G. Lichtschlag	Va = V. Keskin
Gr = R. Gröbel	Rz = R. Rosenzweig	Wk = M. Wieck
Gz = M. Garzarolli	Sg = S. Schurig	Wu = E. Wunder
Hb = H. Baysal	Sk = S. Skaberna	

Table

Star	Min.hel. JD 244...	O-C (I)	O-C (II)	Filt.	Observers	Instr.	Rem.
OO Aql	7805.3476	-.0041	-.0041	V	Ls/Sk/Wu	34	
	8500.4081	-.0039	-.0039	V	Gz/Ho/Rz/Sg	34	
V346 Aql	8482.4325	-.0032	-.0029	V	Wk/Wu	34	
TZ Boo	7612.4617:	-.0711	-.0038	B	Gr	34	
	7613.5025:	-.0705	-.0030	B	Gr	34	MinII
	7967.4154:	-.0776	-.0037	B	Gr	34	MinII
	7967.5592	-.0824	-.0085	B	Gr	34	
	8390.4092	-.0939	-.0124	B	Gr	20	
YY CMi	7540.4730	+.0146	+.0011	V	Sk/Wu	34	
VW Cep	7763.3502	-.0460	-.0011	B,V	Gl/Bk	48	MinII
	7763.4919	-.0435	+.0014	B,V	Gl/Bk	48	
	7767.3850	-.0468	-.0018	V	Sr/Hb	48	
	7767.3857	-.0461	-.0011	B	Sr/Hb	48	
	7767.5255	-.0454	-.0005	B,V	Sr/Hb	48	MinII
EG Cep	8483.3901	+.0118	+.0146	B	Bk/Ld	48	
	8483.3904	+.0121	+.0149	V	Bk/Ld	48	
	8489.3805	+.0113	+.0142	V	Bk	48	
	8489.3819	+.0127	+.0156	B	Bk	48	
	8495.3696	+.0096	+.0124	B	Er/Bk	48	
	8495.3709	+.0109	+.0137	V	Er/Bk	48	
	8516.3388	+.0108	+.0137	V	Bk/Er	48	MinII
	8516.3395	+.0115	+.0144	B	Bk/Er	48	MinII
	8523.4174	+.0093	+.0122	B	Ld/Bk	48	MinII
	8523.4181	+.0100	+.0129	V	Ld/Bk	48	MinII
V1073 Cyg	7748.4413	-.0340	-.0055	B,V	Sr/Bk	48	
	8115.4316	-.0402	-.0095	B,V	Bk/Er	48	
	8482.4268	-.0414	-.0086	B,V	Sr/Bk/Ld	48	
RT Lac	8072.4453	-.0447	-.0068	B	Tn/Sn	48	MinII
	8072.4470	-.0430	-.0051	V	Tn/Sn	48	MinII
	8105.4321	-.0386	±.0000	V	Sn/Va	48	
	8105.4322	-.0385	+.0001	B	Sn/Va	48	
	8110.5059	-.0387	-.0001	V	Sn/Va/Bk	48	
	8110.5076	-.0370	+.0016	B	Sn/Va/Bk	48	
	8166.3147	-.0434	-.0036	B	Tn/Ca	48	
	8166.3185	-.0396	+.0002	V	Tn/Ca	48	
	8171.3916	-.0404	-.0005	B	Ib/Tn/Sn	48	
	8171.3974	-.0346	+.0053	V	Ib/Tn/Sn	48	
	8450.4529	-.0464	-.0007	B	Tn	48	
	8450.4552	-.0441	+.0016	V	Tn	48	
	8483.4239	-.0560	-.0097	B,V	Tn/Sn	48	MinII
	8544.3165	-.0508	-.0032	B	Ca/Va	48	MinII
	8544.3186	-.0487	-.0011	V	Ca/Va	48	MinII
SW Lac	7770.3841	-.0118	-.0052	V	Ls/Sk	34	MinII
XY Leo	7609.3629	+.0177	-.0015	V	Wk/Wu	34	MinII
	7613.3416	+.0191	-.0026	B	Wu	34	MinII
	7626.4092	+.0182	-.0014	V	Wu	34	MinII
	7648.4285	+.0200	-.0001	V	Wu	34	
	7928.4124	+.0264	-.0002	V	Ls/Sk/Wu	34	MinII
XZ Leo	7609.3834	+.0048	-.0011	V	Wk/Wu	34	
FT Ori	7605.4121	+.0041	+.0041	V	Ls/Wk/Wu	34	
UV Psc	8531.4753	-.0061	-.0061	B	Sn/Ca	48	
	8531.4758	-.0056	-.0056	V	Sn/Ca	48	
	8541.3767	-.0067	-.0067	V	Ca	48	MinII
	8541.3773	-.0061	-.0061	B	Ca	48	MinII
	8594.3322	-.0057	-.0057	V	Tn/Sn/Ca	48	
	8594.3333	-.0046	-.0046	B	Tn/Sn/Ca	48	

Table (cont.)

Star	Min.hel. JD 244...	O-C (I)	O-C (II)	Filt.	Observers	Instr.	Rem.
GR Tau	7821.4944	-.0080	-.0005	V	Wu	34	
V471 Tau	7837.31165	+.00073		B	Tn/Ca	48	
	7924.34936	+.00088		B	Sn/Ca	48	
	7959.26854	+.00080		B	Ib/Tn	48	
	7971.25601	+.00106		B	Ib/Tn	48	
	8183.37754	+.00110		B	Ca	48	
	8184.41982	+.00102		B	Ib	48	
V781 Tau	8268.2285	-.0166		B,V	Va	48	MinII
	8268.3996	-.0180		B	Va	48	
	8268.4024	-.0152		V	Va	48	
	8607.2723	-.0194		V	Tn/Va	48	MinII
	8607.2734	-.0183		B	Tn/Va	48	MinII
	8607.4447	-.0194		B	Tn/Va	48	
	8607.4460	-.0221		V	Tn/Va	48	
W UMa	7597.3982	-.0101	-.0101	V	Ls/Wk/Wu	34	
ER Vul	8505.2949	+.0060	-.0048	V	Sn/Va	48	MinII
	8505.2965	+.0076	-.0032	B	Sn/Va	48	MinII
	8512.2743	+.0045	-.0063	B,V	Ib/Ca	48	MinII
	8513.3218	+.0048	-.0060	V	Tn/Sn	48	
	8513.3261	+.0091	-.0017	B	Tn/Sn	48	
	8526.2402	+.0085	-.0023	B	Ib/Ca	48	MinII
	8526.2404	+.0087	-.0021	V	Ib/Ca	48	MinII
	8527.2854	+.0065	-.0043	B,V	Sn/Va	48	
	8528.3362	+.0102	-.0006	B	Ib/Tn	48	MinII
	8528.3368	+.0108	±.0000	V	Ib/Tn	48	MinII

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Reference:

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WHAT IS RX CEPHEI?

RX Cephei is classified as a probable SRD variable in the General Catalogue of Variable Stars (GCVS), with an uncertain period of about 55 days. Its spectral type is G6 II (Keenan & McNeil 1989). Because of its classification it was included in a program of observing yellow semiregular variables (e.g. Zsoldos 1990; Zsoldos & Percy 1991).

RX Cep was observed in 1990–91 with the 60-cm telescope of Konkoly Observatory in Budapest. The comparison and check stars were BD+81°27 and BD+82°30, respectively. The observations are listed in Table I. Their errors are usually smaller than $0^{m}_{.}010$ in V and $0^{m}_{.}015$ in $B-V$.

Table I
Observations of RX Cep

J.D. 2440000+	V	$B-V$
8151.516	7.440	1.101
8163.415	7.438	1.095
8176.364	7.442	1.103
8202.399	7.443	1.099
8502.524	7.440	1.107
8506.460	7.452	1.100
8508.465	7.440	1.107
8534.396	7.436	1.097
8536.399	7.447	1.081
8557.348	7.452	1.075
8561.339	7.448	1.086
8562.392	7.444	1.082
8573.380	7.444	1.093
8597.303	7.449	1.097

The amplitude of the star as given in the GCVS is about 1 magnitude. The observations given in Table I do not confirm this large amplitude, in fact they do not show any variation at all. Since the GCVS amplitude is too large to dismiss it as error of visual observations, it seemed worth to gather all information on the variation of RX Cep from the literature. Table II contains the published amplitudes of the variable between 1880 and 1937. Those marked with an asterisk are not real amplitudes, but the difference between the brightest and faintest points during the whole observing run. It is interesting to note that RX Cep was found constant by Payne-Gaposchkin (1952), too. Since the amplitudes in Table II are usually visual, the values smaller than $0^m.3$ should be considered as (at least) doubtful (e.g. in 1908–12 or 1928–32).

Table II
Amplitudes of RX Cep

Year	Amplitude	Reference
1880–87	1.0*	Knott (1899)
1882	0.6	Knott (1882)
1908–12	0.2*	Wendell (1913)
1911–23	0.7*	Jost (1933)
1915–19	0.4*	Luyten (1922)
1920–23	0.4*	Hassenstein (1925)
1923–32	0.5	Parenago (1938)
1928–32	0.3*	Carrasco (1935)
1931	0.3*	Rybka (1937)
1931	0.3	Zverev (1936)
1933–36	–	de Sitter (1937)
1937	0.4	Zverev (1938)

Obviously further observations are needed to determine the nature of RX Cep. If the large amplitudes are real in Table II, then RX Cep is a star deserving more attention.

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PHOTOELECTRIC MINIMA OF ECLIPSING BINARIES

We present new photoelectric times of minimum of five eclipsing binaries. Their periods lie between 1 and 3 days and the primary or both components are of relatively early spectral type. Our photoelectric observations were carried out with a 35 cm Cassegrain reflector at the R. Szafraniec Observatory in Metzerlen, Switzerland, during the period from August to October 1991. A single-channel photoelectric STARLIGHT-1 photometer, furnished with an unrefrigerated EMI 9924A tube and standard Johnson B filter, was used. The 13 new times of primary and secondary minima and their errors were determined using the Kwee - van Woerden (1956) method.

TV Cas

The period changes of this well-known eclipsing binary have been discussed frequently (Frieboes-Conde & Herzeg 1973, Tremko & Bakos 1977). Two new epochs of primary minimum are listed in Table 1, where N means the number of points used for the time determination. Fig. 1 shows the O-C diagram for all photoelectric times of minimum found in the literature (De Landtsheer 1983, and references therein). From this figure it is very difficult to determine the nature of the period change.

If we assume that the dominant period variation is caused by the presence of a third body and that all observed times of minimum cover approximately one period of the circular third-body orbit, we find new linear light elements:

Pri. Min. = HJD 2444602.4474 + 1.81260217·E,

and we can derive the following light-time effect parameters:

P ≅ 20 460 days ≅ 56 years,
semi-amplitude = 0.017 days.

These elements and all others given in this paper were computed using the least squares method. The theoretical curve is plotted as a dashed line in Fig. 1. The mass function amounts to $f(m_3) = 1.39\ M_\odot$ (Tremko & Bakos, 1977), the minimum mass of the third body is $m_3 = 0.6\ M_\odot$.

More timings of high accuracy are needed for this interesting object.

ZZ Cep

No discussion or comment on the change of period of the eclipsing binary ZZ Cep was found in the literature covering the last 25 years. Kandpal and Srivastava (1967) presented photoelectric observations (in V) and derived photoelectric elements and absolute dimensions of this system. Four newly observed times of minimum are presented in Table 1.

Using only the photoelectric timings published in the literature and one normal point derived by Kwiek (1936), we obtain the following light elements

Pri. Min. = HJD 2427928. 4519 + 2.14179954·E,

which are practically identical to those published by Herbig (1947).

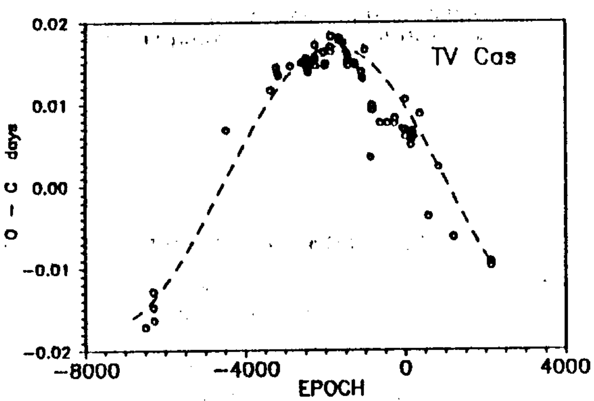

Fig. 1: O–C diagram for photoelectric times of minimum of TV Cas. The dashed curve is computed according to the light–time effect parameters.

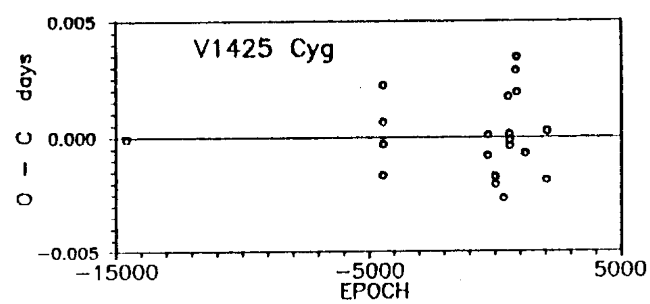

Fig. 2: O–C diagram for photoelectric time of minimum of V1425 Cyg. The small square denotes the mean of photographic observations obtained by Strohmeier at HJD 2427714.2597.

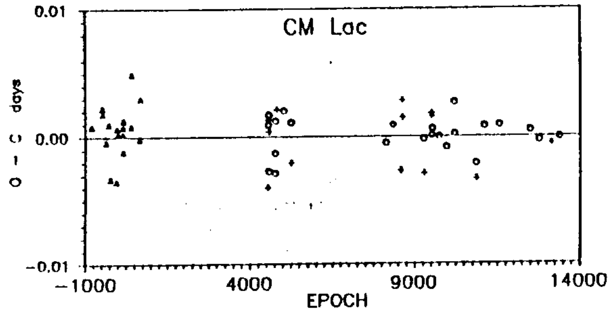

Fig. 3: O–C diagram for CM Lac. The circles and plus sign are the photoelectric times for primary and secondary minimum. The triangles denote the older photographic results published by Wachmann (1935, 1936).

Table 1

star	JD Hel. – 2400000	error [10^{-4} d]	min type	N	filter
TV Cas	48481.4069	1	I	37	B
	48490.4693	1	I	29	B
ZZ Cep	48485.4433	1	I	25	B
	48500.4348	1	I	29	B
	48532.560	12	I	8	B
	48545.4120	8	I	14	B
V1425 Cyg	48506.3960	2	I	22	B
	48533.3245	1	II	28	B
CM Lac	42276.5021	6	II	35	V
	42276.5020	6	II	32	B
	42280.5123	2	I	37	V
	42280.5123	3	I	43	B
	42284.5258	3	II	30	V
	42284.524	27	II	20	B
	42309.3972	3	I	44	V
	42309.3973	2	I	45	B
	48093.5063 ⋆	19	II	10	B
	48495.4820	2	I	20	B
	48503.5054	1	I	24	B
EE Peg	48486.4656	3	I	15	B
	48507.4929	1	I	27	B

⋆ published also in BBSAG Bull. No. 96

V1425 Cyg

A photometric study of the early-type Algol variable V1425 Cyg (= BV 346) was presented by Lee (1989). In this system the hot component is also the more massive one and it is therefore called a "reverse Algol" system. One new primary and secondary minimum is presented in Table 1.

Using only the photoelectric timings published in the literature (Lee 1989) and one point as the mean of 14 photographic observations provided by Strohmeier (Tate 1970), we derived the following improved light elements:

Pri. Min. = HJD 2445969.0607 + 1.25238755·E,

which are in a good agreement with the elements computed by Lee (1989). The corresponding O–C diagram is plotted in Fig.2.

CM Lac

In Table 1 we list the times of minimum computed from the original photoelectric measurements published by Murnikova & Makarchikova (1981). For the primary minima, using Kwee–van Woerden's (1956) method, we obtained slightly different results, and four times of secondary minimum were not found in the literature. In this table we also present our three newly determined times.

Using only the photoelectric timings published (Alexander 1958, Caton et al. 1991), one can derive the following light elements:

$$\text{Pri. Min.} = \text{HJD } 2427026.3158 + 1.60469140 \cdot E,$$

which are practically identical to Alexander's (1958) results. This means that the system CM Lac demonstrates very good constancy of its period over an interval of about 60 years. The O–C diagram is plotted in Fig. 3.

EE Peg

A very comprehensive study of the eclipsing binary EE Peg was published by Lacy & Popper (1984). In their paper, the presence of a third star was inferred from its effect on the radial velocities of the eclipsing pair. The period of the third body orbit was found spectroscopically to be 1464 days. The newly observed times of primary minimum are presented in Table 1.

Using only the photoelectric timings published, we derive the following current light elements:

$$\text{Pri. Min.} = \text{HJD } 2440286.4363 + 2.6282159 \cdot E.$$

This period is slightly longer than the one used by Lacy & Popper ($2^{d}_{.}62821423$). Unfortunately, the period of the third body orbit given above cannot be confirmed photoelectrically. The Fourier analysis of the O–C residuals employing the photoelectric results favor a shorter period of either 235 or 658 days.

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ON HOUR-SCALE PHOTOMETRIC VARIATIONS OF TT ARIETIS

The cataclysmic variable TT Ari was observed photometrically during an international campaign in 1988. Tremko *et al.* (1990) and Hudec *et al.* (1989) published the results of sudden decreases in the brightness. From the whole data set we chose 15 relatively long runs to test reality of a 4.68-hour secondary photometric period (Wenzel *et al.*, 1986; Andronov *et al.*, 1992). These runs were obtained mainly by the authors (4 in Sonneberg, 4 in Skalnate Pleso, 4 in Cracow and 1 in Piszkéstető), and 2 were published by Andronov *et al.* (1992).

The original observations were averaged over bins of duration tipically less than $0^{d}.06$. Their number n_{α_j} in j^{th} bin in α^{th} run was used as "weight" for the least squares solution

$$\begin{aligned} m_{\alpha_j} &= a_\alpha + s_1 \sin\left(2\pi f_1\, t_{\alpha_j}\right) + c_1 \cos\left(2\pi f_1\, t_{\alpha_j}\right) \\ &\qquad + s_2 \sin\left(2\pi f_2\, t_{\alpha_j}\right) + c_2 \cos\left(2\pi f_2\, t_{\alpha_j}\right) = \\ &= a_\alpha - r_1 \cos\left[2\pi f_1\left(t_{\alpha_j} - t_1\right)\right] - r_2 \cos\left[2\pi f_2\left(t_{\alpha_j} - t_2\right)\right] \end{aligned} \tag{1}$$

where m_{α_j} and t_{α_j} are averaged values of the magnitude and time in j^{th} bin, and a_α, s_1, c_1, s_2, c_2 are the parameters being determined for trial frequencies f_1 and f_2. The moments t_1 and t_2 correspond to a maximum brightness of waves with amplitudes r_1 and r_2. The function $S(f_1, f_2) = \sigma^2_{O-C}(f_1, f_2)/\sigma^2_0$ was used as a test function, where σ^2_{O-C} and σ^2_0 are weighted variances of residuals from the fit (1) and from nightly mean. A total number of averaged observations is n = 478, a r.m.s. deviation from nightly means is $\sigma_0 = 0^{m}.048$.

The shifts a_α for each night were computed as best fit parameters, thus taking into account their possible night-to-night changes. The first reason for this is that there may exist systematic differences among brightness values obtained at different telescopes in instrumental systems. Secondly, there may exist physical variations in the mean brightness from night to night.

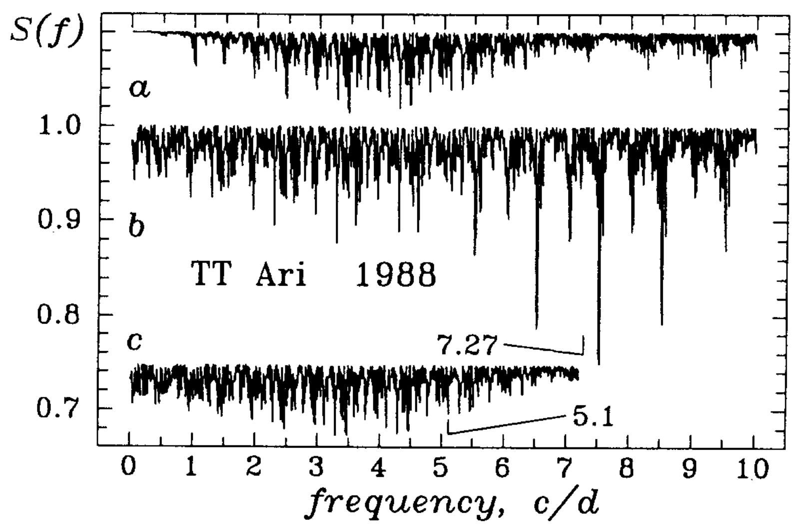

Fig. 1 Periodograms for 478 mean points of TT Ari obtained in 1988. Vertical bars correspond to the spectroscopic frequency (7.27 c/d) and previously detected secondary oscillation (5.1 c/d).

a) $S(f_2)$ +0.10 is a shifted periodogram for prewhitened observations;
b) $S(f_1,0)$ is a periodogram without taking into account the variations with a secondary period;
c) $S(f_1,f_2)$ is a periodogram for a two-frequency model (1), where f_1 was slightly corrected to obtain a minimum value of the test-function.

Table 1

Parameter fits of TT Arietis

f_1	f_2	r_1	r_2	t_1	t_2	$S(f_1,f_2)$
7.5217	3.2914	0.032	0.016	39.8975	39.8432	0.673
7.5216	3.4635	0.036	0.020	39.9007	39.7631	0.672
7.5217	4.2918	0.033	0.020	39.8975	39.9993	0.674
7.5211	4.4614	0.037	0.019	39.9007	39.9284	0.678
7.5211	5.1074	0.037	0.016	39.8984	39.9576	0.695
7.5215	–	0.035	–	39.8979	–	0.747

By using non-linear least squares procedure in the vicinity of the previously found values $f_1 = 7.5346$ cycles/day and $f_2 = 5.123$ c/d (Wenzel *et al.* , 1986), we found that $f_1 = 7.5211$ c/d and $f_2 = 5.1074$ c/d. The corresponding best fit parameters are listed in Table 1.

For a wide-range period search, we also computed a periodogram $S(f_1, 0)$ corresponding to one-frequency model with 17 unknown parameters ($a_{\alpha j}, j = 1, \ldots, 15$; s_1, s_2). It is shown in Fig. 1b. The most prominent feature in this periodogram occurs at $f_1 = 7.5215$ c/d. Several features at daily bias frequencies $f_1 \pm 1$, $f_1 \pm 2$ are seen as well, corresponding to a spectral window of observations.

A linear ephemeris for the moments of maximum brightness obtained for our observations in a time interval J.D. 2447411-2447471 is as follows:

$$Max.\,HJD = 2444739.898 + 0.132953E \qquad (2)$$
$$\pm\ 2 \qquad \pm\ 13$$

This value of the photometric period differs significantly from $P_1 = 0^d.132771$ published by Wenzel *et al.* (1986) for observations obtained in 1986, as well as from $P_1 = 0^d.13277082$ (Roessiger, 1988). However, it is close to $P_1 = 0.132957$ published by Udalski (1988) for observations obtained in 1987-1988. Udalski (1988) also suggested that this photometric period may undergo real long-term changes. It may be noted that it differs by a few per cent from the period $P_{SP} = 0^d.13755114$ (Thorstensen *et al.*, 1985) of spectral variations.

Such discrepancy allows to classify TT Ari as an intermediate polar, despite the rotational period of the white dwarf is still unknown (Schwarzenberg-Czerny, 1990).

To search for a secondary period in a wide frequency range we used two methods. At first, a one-frequency model was applied to the prewhitened observations $m'_{\alpha_j} = m_{\alpha_j} - a_\alpha + r_1 \cos 2\pi f_1 (t_{\alpha_j} - t_1)$ with r.m.s. deviation $\sigma_1 = 0^m.041$. A corresponding test function $S(f_2) = \sigma^2_{O-C}/\sigma^2_1$ is shown in Fig. 1a. It shows a variety of dip features, the most prominent of which does not coincide in frequency with the previously obtained value of f_2 (Wenzel *et al.*, 1986). Secondly, we computed a test function $S(f_1, f_2)$ (Eq. (1), Fig. 1c), which exhibits similar behaviour.

The relatively large noise at low frequencies corresponds to larger value of estimated parameters (l=19) as compared with l=3 (Fig. 1a). The relative depths of dips in Fig. 1a differ from those in Fig. 1c, but their frequencies coincide within the error estimates. Best fit parameters for four most prominent dips are listed in Table 1. Their frequencies exhibit well pronounced biases. However, the durations of our individual observational runs are not sufficient to cover the corresponding periods $P_2 = 1/f_2$, thus new observations longer than 5-6 hours are needed to solve the problem of a secondary photometric period.

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NEW FLARE STARS AND REPETITIONS IN THE ORION ASSOCIATION REGION

Photographic material of the Orion association from Tonantzintla Schmidt plates covering the interval 1978–82 and re–examination of old plates allowed us to find 20 new flare stars and 20 flare–ups of known flare stars. The effective observational time is 104 hours.

Table 1
New flare stars in Orion association

No. Ton	Star Parenago	R. A. 1900	Dec. 1900	U mag	ΔU mag	Spec. Type	Date of Flare	Ref.
340		$5^h22^m.4$	$-5°45'.$	16.7	1.3		27.01.65	
341		24.5	−7.28	16.8	2.8		21.01.82	
342		25.4	−6.33	>18.4	>3.4		03.01.82	
343		26.4	−6.09	>18.4	>3		22.01.82	
344		27.4	−6.38	>18.6	>2.6		05.02.65	
345		28.0	−6.10	>18.4	>3.9		26.10.81	
346	1062	28.0	−4.51	16.8	2.6		26.10.81	
347		28.9	−7.20	>18.5	>2.8		29.12.64	
348		29.0	−4.25	17.6	0.5		26.01.65	
349	V 1118	29.8	−5.38	>18.8	>2.0	eα	07.02.67	1.2
350	1631	29.9	−4.33	16.2	1.6		19.01.66	
351		30.4	−4.20	>18.6pg	>2.2pg		21.10.62	
352	2220	30.9	−4.02	16.1	0.6		10.01.82	
353		31.0	−4.17	>18.4	>2.4		24.12.65	
354		32.3	−4.05	18.2	2.8		11.02.78	
355	2612	33.0	−6.43	15.2	2.9		26.01.82	
356		33.2	−5.05	16.5	0.9	eα	21.01.82	3
357	2685	33.6	−5.07	15.0	1.3		07.01.81	
358		35.2	−5.36	17.0pg	0.9pg		23.10.62	
359		37.4	−5.31	16.6	0.9		23.01.82	

References: 1. Gasparian et al. (1990) 2. Parsamian et al. (1991) 3. Parsamian, Chavira (1982)

Table 2

Repeated flares in Orion association

No. Ton	Star Parenago	U mag	ΔU Type	Spec. Flare	Date of	Ref.
12		17.3	2.1	eα	19.01.82	1
71		17.5	2.0		23.01.82	
143	1502	17.6	1.5	eα	21.01.82	
150		18.3	2.9		2.01.82	
176		16.8	0.8	eα	29.12.81	2
219	1609	16.8	2.2		19.01.82	
224	1790	16.2	1.1		23.12.81	
257		17.2	1.9		08.01.65	
260		17.4	1.9		29.01.65	
294		18.5	2.7		14.02.66	
296		17.3	2.1		13.12.72	
328	2186	17.2	4.3	eα	31.01.81	1
333	2326	16.0	2.4	eα	24.01.82	1
349	V1118	>18.8	>2.6	eα	12.01.77	3, 4
349	V1118	>18.8	>3.1	eα	11.01.81	
350	1631	16.2	0.8		24.12.76	
⋆	V1143	18.6		eα	20.01.63	4, 5
	V1143	18.6	2.0		07.04.88	4
AB 18		18.0	1.0		28.12.59	
AB 105		16.1	0.9		13.12.72	

References: 1. Haro (1953), 2. Haro (1976), 3. Gasparian et al. (1990), 4. Parsamian et al. (1991b), 5. Marsden (1983).

⋆This flare was observed spectroscopically.

The results obtained from the present examination and re-examination are given in Tables 1 and 2. In the columns of Tables 1 and 2 the following data on flares are presented respectively: the Tonantzintla number of stars, number from Parenago's catalogue, the approximate equatorial coordinates, ultraviolet magnitude at minimum, the amplitude of flare event, the spectral type, the date of flare.

Flare ups of stars T12 and T143 can be considered as slow ones.

In Table 1 we continue the Tonantzintla numeration (Parsamian et al., 1978). Recently re-examination of all photographic material covering essentially the interval from 1959 to 1978 allowed us to find 33 new flare stars and 83 repetitions. The new ones received numbers Ton261–298 (Chavira, Parsamian, 1991).

Some numbers of Ton do not exist at all, they are 255, 256, 258, 259, 299–325 and T278= T142, T282=B19, T284=U7, T286=R5, T289=AB17. A more detailed article is going to appear in Rev. Mexicana Astron. Astrof.

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PHOTOMETRY OF TWO BRIGHT EARLY-TYPE BINARIES: HD 101205 and HD 152248 [1])

During observing periods with the 50 cm telescope at La Silla in February/March and May 1992, several early-type eclipsing binaries were measured in the UBV system. Here the results on two of them are reported. Both are listed in the New Catalogue of Suspected Variable Stars (Kholopov 1982), are members of open clusters and are brighter than 6.5^m, though not listed in the Bright Star Catalogue.

HD 101205: A member of the open cluster IC 2944; NSV 5277, spectral type is O7 III n((f)) according to Walborn (1973). Recently Balona (1992) discovered that this star is an eclipsing binary with a period of 2.084^d (in this paper HD 101205 was erroneously designated as HD 101191). Our new light curve is plotted in Fig. 1. The comparison star was HD 101298, the check star HD 101131. A normal minimum time of JDhel. 2448684.737 ± 0.004^d was derived from the light curve. Unfortunately the period is not known accurately enough to fix the number of cycles between our new minimum and Balona's determination unambiguously; among the possible alias periods, the value closest to the period given by Balona is 2.0842^d . The amplitude in both minima is about 0.08^m, in agreement with Balona's measurements. According to Thackeray and Wesselink (1965) as well as to Ardeberg and Maurice (1977), the star has variable radial velocity (SB1 type).

HD 152248: This is a member of the well-studied open cluster NGC 6231; NSV 8022, spectral type is O7 Ib:(n)(f)p according to Walborn (1972). Perry et al. (1991) classified the star as EB - but no period or light curve has been published. As known from spectroscopy by Struve (1944), Hill et al. (1974) and Levato and Morrell (1983), the star is of SB2 type with a period close to 6 days (two radial velocities reported by Hayford (1932) also do not contradict this period). From our Feb./March photometry the period should be about 5.85^d ± 0.05^d . The May data, compared with this photomertry, are shifted by 63.95^d ± 0.04^d ; this shift must equal to 11 cycles, yielding an

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[1]) Based on observations collected at the European Southern Observatory, La Silla, Chile

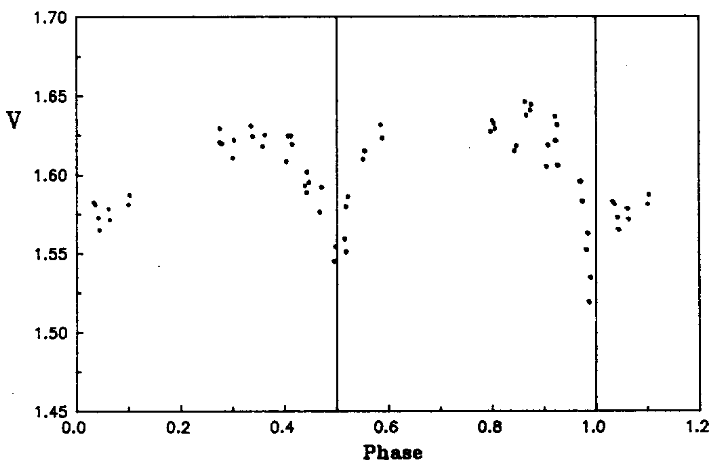

Fig. 1. Light curve in V colour of the eclisping binary HD 101205. Differences of magnitudes HD 101205 minus HD 101298 are given.

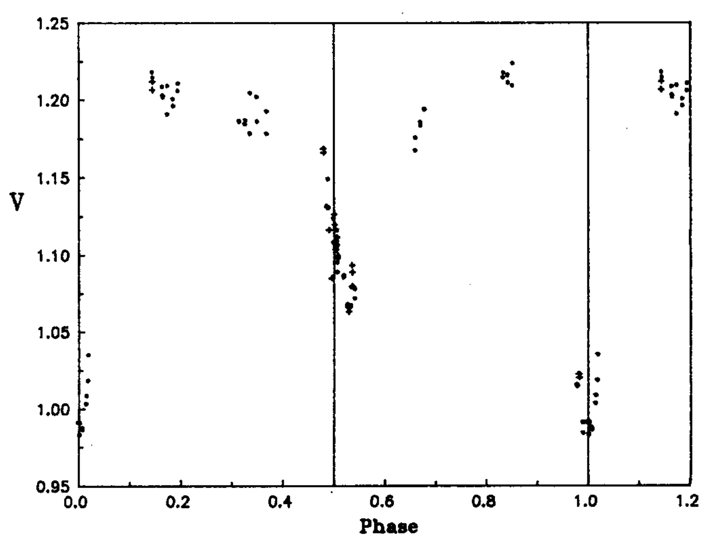

Fig. 2. Light curve in V colour of the eclipsing binary HD 152248. Differences of magnitudes HD 152248 minus HD 152147 are given, ephemeris is Pri.Min. = JDhel. 2448688.77 + 5.814^{d} E. Points - data from JD 2448682 to 2448691, crosses - data from JD 2448749, 2448752, 2448753 and 2448755.

improved period of $5.814^d \pm 0.004^d$. Further information on the period should follow from the spectroscopic conjunction phases. However, the present accuracy of the period is not sufficient to rule out all aliases when considering the complete sample of all individual observations. The radial velocity curves are affected by such a large scatter that they cannot help in resolving the ambiguity. Due to the same reason, the eccentricity determined from spectroscopy (Hill et al.: e = 0; Levato and Morrell: e = 0.18) is of low weight. It however seems, that a non-zero eccentricity is supported by photometry, since the secondary minimum phase is 0.525 ± 0.010. Definite values of the period and eccentricity can hopefully be determined from future photometry scheduled for 1993. Our V light curve is plotted in Fig. 2. HD 152147 and 152314 served as comparison and check stars and were always measured with the variable, and no sign of variability was detected.

The time of the primary minimum is JDhel. 2448688.77 and amplitudes of minima are 0.24^m (primary) and 0.13^m (secondary) in all colours. HD 152248 is one of the earliest eclipsing binaries known. Its further study can help to improve our limited knowledge of accurate parameters and the temperature scale of hot stars.

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ON THE PERIOD–LUMINOSITY RELATION IN THE INFRARED FOR FIELD RR LYRAE STARS

Liu and Janes 1990 (hereafter LJ90) derived $<M_V>$ values for 13 RR Lyrae stars in the galactic field using the modern modification of the Baade–Wesselink method. For 12 of these objects they gave mean observed dereddened $<V>$ and $<I_c>$. Therefore one can easily convert $<M_V>$ to $<M_{Ic}>$: $<M_{Ic}>=<M_V>-(<V>-<I_c>)$. Slightly revised $<M_V>$ magnitudes of these stars have recently been published by Jones et al. 1992 (hereafter J92) ; as a rule the differences equal to -0.03 mag.

I accepted $<M_V>$ magnitudes from J92 omitting (together with these authors) the highly reddened star AR Per. I eliminated also AV Peg owing to its too high metallicity [Fe/H]= + 0.0 being not typical for the majority of RR Lyrae stars, also bearing in mind that $<M_{Ic}>$ magnitudes are not as insensitive to [Fe/H] as $<M_K>$ ones. I consider the weighted mean reddenings for field RR Lyrae stars in LJ90 to bee good, excluding only the case of the RRc star T Sex. I accepted for T Sex E(B−V)= 0.01 instead of 0.05 in LJ90 (se my paper about the HR diagram for variables in the globular cluster M 3 in the infrared, to be published elsewhere). Needed values of interstellar absorptions A(V) and A(I_c) were recalculated for T Sex by the author. Since changing E(B−V) must change also the value $<M_V>$, I introduced the correction $\Delta M_V = + 0.14$ for T Sex, taking into account the influence of the reddening error on the derived $<M_V>$ magnitude according to Table 9 of LJ90. The derived magnitudes $<M_{Ic}>$ are given in Table 1 for 10 field RR Lyrae stars together with their log P_F values (for the case of fundamental pulsation, adding + 0.127 for RRc stars). [Fe/H] data in Table 1 are from J92.

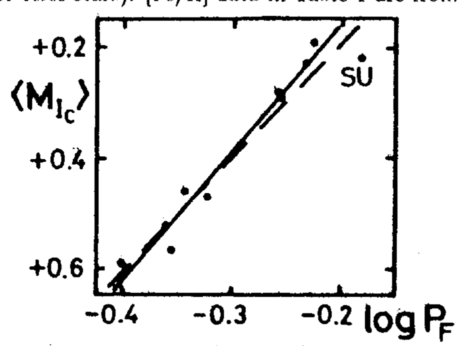

Fig. 1. $<M_{Ic}>$ − log P_F relations for field RR Lyrae stars; dotted line with the evolved star SU Dra included, solid line without it.

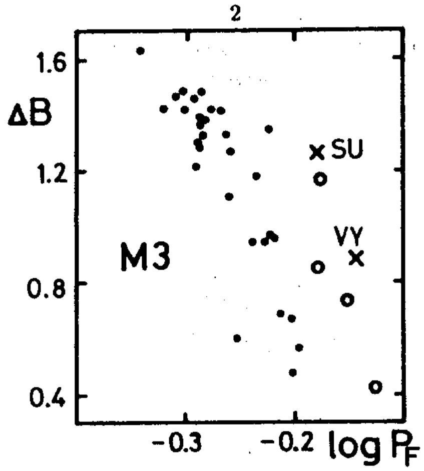

Fig. 2. B light amplitude – log P_F diagram for RR Lyrae stars of M 3 (dots and circles, latter for evolved stars) and for two field variables (SU Dra and VY Ser).

Table 1

Star	log P_F	$<M_{Ic}>$	[Fe/H]
SW And	−0.355	+0.57	−0.15
RR Cet	−0.258	+0.28	−1.25
SU Dra	−0.180	+0.22	−1.60
RX Eri	−0.232	+0.23	−1.40
RR Gem	−0.400	+0.59	−0.20
RR Leo	−0.345	+0.46	−1.15
TT Lyn	−0.224	+0.19	−1.35
T Sex	−0.361	+0.52	−1.20
TU UMa	−0.254	+0.29	−1.25
UU Vir	−0.322	+0.47	−0.55

Fig.1 shows that only $<M_K>$ correlates with log P_F well, but also the magnitudes $<M_{Ic}>$ demonstrate good enough period-luminosity relation for the field RR Lyrae variables:

$$< M_{Ic} >= -2.06 log P_F - 0.22 \text{ (dotted line).}$$
$$\pm 0.18 \qquad \pm 0.06$$

The inclusion of several objects significantly evolved from the zero–age horizontal branch (ZAHB) into the sample of RR Lyraes can change the slope of the derived period–luminosity relation. Sandage (1981, 1990) showed that in a given globular cluster the stars most evolved from ZAHB have the longest periods and they are the brightest among RR Lyrae variables having the same colours or the same light amplitudes. This period shift effect was used by J92 to exclude evolved stars from the whole sample of RR Lyraes having $<M_V>$ and $<M_K>$ determinations.

Comparing the field stars with the cluster objects, J92 did not take into account that some stars in a given cluster can also be evolved objects. As results, VY Ser (log P = −0.146) was not recognized by J92 as an evolved star, and SU Dra (log P = −0.180) was only suspected by them to be an evolved star, both stars being in fact sufficiently evolved RR Lyrae variables. Fig. 2 shows a part of Fig. 11 from J92 with the period −B amplitude diagram for RRab variables in M 3. I plotted by circles in Fig. 2 evolved M 3 stars according to Sandage (1981), with exclusion of the star 96 having not the longest period at its colour; VY Ser and SU Dra are indicated. Both VY Ser and SU Dra well deviate from "normal" M 3 variables. Moreover, VY Ser ([Fe/H] = −1.80), in spite of its metal deficiency being not so strong as that of the RR Lyrae stars in the globular cluster M 15 ([Fe/H] = −2.20), has the same period and light amplitude as the star 9 in M 15, which is an evolved variable in this cluster. Indeed, the analysis of the data from Sandage (1990; his Table 6) shows that the star 9 in M 15 has by far the longest period (log P = −0.146) at its light amplitude (0.90 B), also being at its colour $<B> - <V> = 0.40$ one of the brightest variables in this cluster.

So, VY Ser and SU Dra must be eliminated from the sample of J92 and, as a consequence, the slope of their relation $<M_K>$−log P_F must be essentially greater than −2.33 log P_F:

$$\begin{array}{l} < M_K >= -2.59 log P_F - 0.98 \\ \qquad\quad \pm 0.21 \qquad\quad \pm 0.07 \end{array}$$

The same conclusion is right for the case of my $<M_{Ic}> -$ log P_F relation, and the real relation must be the following (without SU Dra, an evolved star):

$$\begin{array}{l} < M_{Ic} >= -2.33 log P_F - 0.31 \qquad \text{(Fig. 1).} \\ \qquad\quad \pm 0.16 \qquad\quad \pm 0.05 \end{array}$$

One cannot exclude the possibility that the different slopes of $<M_K> -$ log P_F relations in different globular clusters (Longmore et al. 1990) may be partly connected with an occasional inclusion of significantly evolved members of a given cluster.

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PZ Mon - THE FLARE STAR WITH THE LARGEST AMPLITUDE OF THE LONG-TERM LIGHT VARIABILITY

PZ Mon has been suspected as a K2 flare red dwarf by L. Munch and G. Munch (1955) after the changes in the hydrogen and calcium emission lines have been detected in its spectrum. In fact, this suspicion was confirmed by photometric measurements of PZ Mon brightness from the Harvard Observatory plate collection carried out by S. Gaposhkin (1955): several sudden brightness variations have appeared with photographic amplitude up to $0^m_.66$. Photoelectric patrol observations in 1967–1972 did not reveal high amplitude flares: only one flare with $\Delta m = 0^m_.11$ was registered during 40 hours of V-monitoring, the B-monitoring during 15 hours did not detect any flare (Cristaldi et al.,1968; Cristaldi & Rodono, 1970). Using the Bergedorf photographic plates A. A. Wachmann (1968) found that the brightness of PZ Mon remained in its high state ($m = 9^m_.9$–$9^m_.6$) during 100-150 days, then slowly decreased down to $10^m_.6$, occurred at time interval for more than 100 days. According to Petit (1959), PZ Mon is a flare star of UV Ceti-type.

We have searched for long-term variability of PZ Mon using the Sternberg Astronomical Institute of Moscow University (SAI) plate collection. Preliminary analysis of the yearly mean magnitudes obtained as separate rows of data for 1899–1989, showed the existence of the variability with a large amplitude up to 1 magnitude. Similar variability amplitude estimations are given by Kurochkin from his analysis of the SAI collection (private communication). The possible presence of a cycle-like variations with an apparent period of several dozens of years is also detected, but the fragmentary nature of the observations make this result uncertain (Bondar', 1990). Further study of the star is based on the Odessa Astronomical Observatory collection covering the time interval 1968–1989 and to a greater extent on the Sonneberg plates archive allowed to obtain more data in 1928–1991. The yearly mean light magnitudes were reduced to the scale of the SAI measurements: the correction values for data from the Sonneberg archive and from the Odessa collection were $+0^m_.06$ and $-0^m_.2$ respectively. The flares and uncertain measurements have been excluded from the analysis . All of the available data and standard deviations of a single measurement from the annual mean are given in the light curve in Figure 1a. The lower part of the Figure shows the light curves of two comparison stars, the brighter one was used for the Sonneberg collection. The stellar magnitudes of the comparison stars were measured relatively to the five photometric standard stars (Shugarov, 1976) using the iris-photometer. The sensitivity of the plates should be close to B band, but this does not rule out that a difference may exist between the photoelectric values and measured magnitudes .

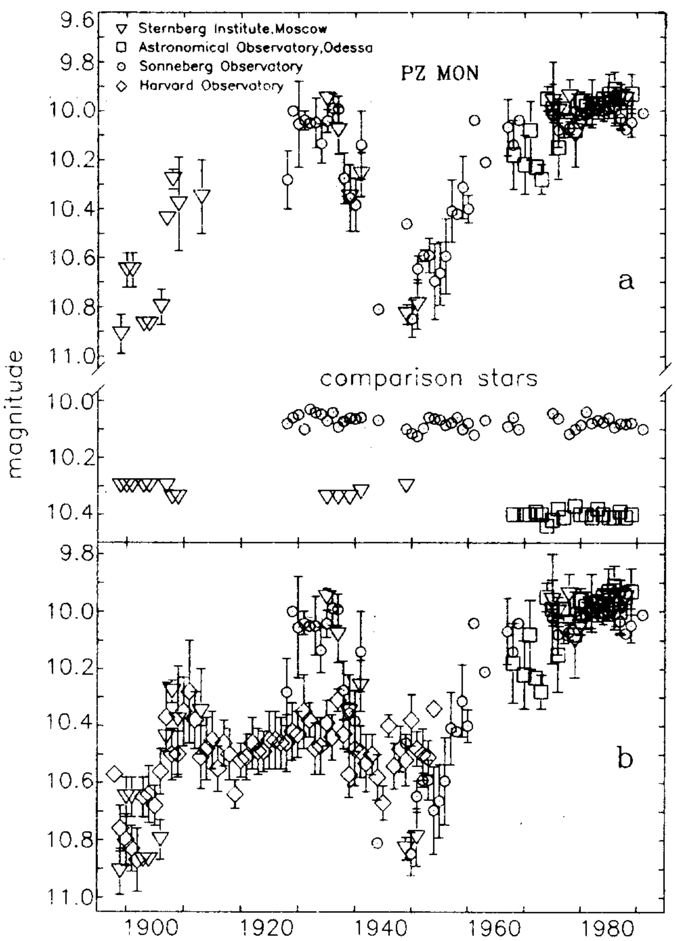

Figure 1: PZ Mon long-term variability

The light curve represented in Figure 1a illustrates the long-term photometric behavior of PZ Mon from 1899 to 1991. It shows two maxima and two minima, the time interval between them is about 50 years. At minimum the light fades down to 10.9, according to other estimations down to 11.0–11.2 mag. At maximum the stellar magnitudes cover the range of 9.9–10.0 mag. The star remains at maximum for 10–15 years and at minimum, probably for less than 10 years. Its high state has been interrupted by short-lived light minimum with depth of 0.2–0.3 mag. It is known, that long-term light variations are found for several red dwarfs of BY Dra type. This phenomenon is being interpreted in terms of activity cycle similar to the solar 11-year one. The duration of a stellar cycle is being estimated usually as the time between minima of brightness, corresponding to the highest inhomogeneity of the visual stellar surface. The light curve of PZ Mon indicates also the repeated presence of the extreme values of the mean brightness repeated on a timescale of nearly 50 years.

Let us compare this light curve with the data obtained S. Gaposhkin. He has measured the brightness of the star relatively to the comparison stars, whose magnitudes had been determined according to the standard in IPg (Gaposhkin, 1955). These values give a continual row of mean values for 1898–1954. Figure 1b contains the data from Figure 1a supplemented by results of S. Gaposhkin. The Harvard measurements confirm the value of the first maximum and light variations on the following ascending branch, as well as the maximum at the end of 20–ies and in the mid 30–ies, the light decreasing by $0^{m}.2$ during the maximum and the minimum observed in 1944–1950. However, since 1910 the long-term variations of the mean brightness, according to Gaposhkin, show lower amplitude than in other collections and in the time interval from 1910 to 1920 the light of the star does not increase, but on the contrary, decreases down to its minimum in 1919.

Thus, the considered photometric investigations of the PZ Mon evidences about the presence of long-term light variations with a remarkable amplitude and allow us to suspect the cyclic character of these variations. The duration of the cycle is about 25–50 years long. Currently, cyclic variations with the typical time 50–60 years are known only for the three of BY Dra type stars: BY Dra itself, CC Eri and BD+26° 730 (Phillips & Hartmann,1978; Hartmann et al., 1981). The greatest photometric variability on this time span has been found for BD+26° 730 with the amplitude of 0.6. The amplitude of PZ Mon is exceeding this value significantly.

I should like to express my thanks to Dr. W. Götz for interest to this research and support during my visit to Sonneberg Observatory. Many thanks to the SAI and Odessa Astronomical Observatory collaborators for their help in usage plate archives.

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Θ^2 Sgr: SERENDIPITOUS DISCOVERY OF VARIABILITY IN AN Am STAR?

The bright star HR 7631 was recently found to be a strong X-ray source by both the X-ray telescope (XRT) and wide-field camera (WFC) aboard the ROSAT X-ray satellite. This activity, along with the large rotational velocity of ~ 90 km s^{-1} (Dr. R.D. Jeffries[1], private communication) suggested that the star may show evidence of variability due to photospheric spots, and in July 1992 it was included in the observing program at the Monash Observatory.

Comparison stars chosen were HR 7585 (HD 188158) and HR 7624 (HD 189118, also known as Θ^2 Sgr), both of which are within 1^o of the target star. Preliminary observations on July 16^{th} yielded 28 V-band measurements of HR 7631, and while reducing these data it was immediately noticed that the RMS deviation in comparison star differences was very large. The data are shown in Figures 1 (a) and (b) as magnitude differences between target and comparison stars. The minimal scatter in the points indicates the very high quality of the night. It can be seen from Figure 1 (a) that the difference between HR 7631 and comparison star 1 remained reasonably constant over the seven hours of observations, with an RMS deviation of only 0.007 magnitude. Assuming then that neither of these stars were varying, Figure 1 (b) indicates that the second comparison star (Θ^2 Sgr) experienced a steady 0.25 magnitude increase in brightness. In addition, a flare-like event from the star was seen at about HJD 2448820.11. This showed as a rapid increase in brightness of 0.07 magnitude (corresponding to a luminosity increase in the star of about 7%), followed by an approximately exponential decrease over the next 25 minutes or so.

Θ^2 Sgr is not listed in the Bright Star Catalog as a variable star, and in fact a literature search showed it to be an Am star (Henry & Hesser, 1971). Wolf (1983) gives a detailed summary of research on peculiar A stars, saying "several extensive searches for photometric variability in the Am stars, have yielded, with few exceptions, negative results", and concludes that there is no evidence for either pulsation or surface inhomogeneities (starspots) for these objects. This is clearly at odds with the data shown in Figure 1 (b) Future observations will be made as soon as possible to verify these findings, although the evidence presented here strongly suggests photometric variability – probably due to starspots – and flaring of the Am star Θ^2 Sgr. The ROSAT target HR 7631, although listed in the Bright Star Catalog as a variable of amplitude 0.07 magnitude, showed little change over the duration of these observations. The star may simply have been in a quiescent state of photospheric activity, and further observations will examine this.

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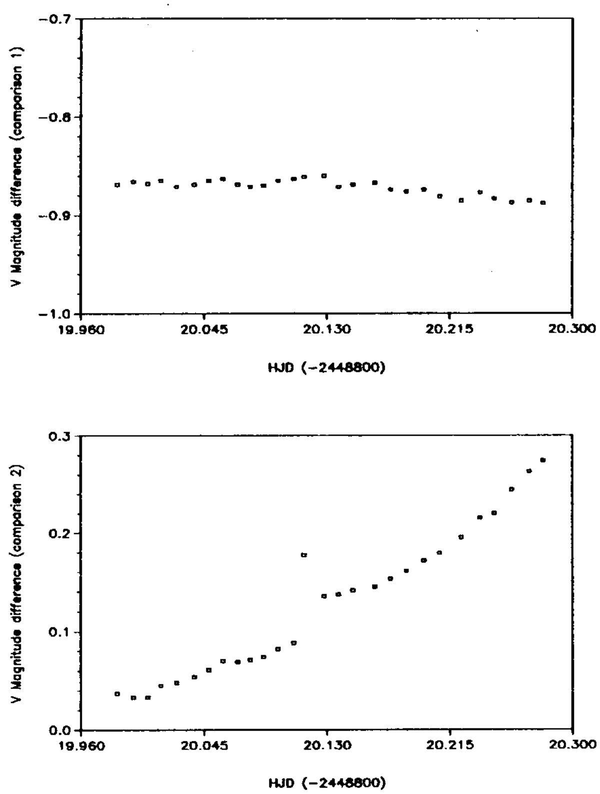

Figure 1: Magnitude differences between HR 7631 and comparison stars (a) HR 7585 and (b) HR 7624. Measurements were made in the V filter and span approximately 7 hours.

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NEW TIMES OF LIGHT MAXIMUM OF EH Lib

It is well known that the study for the secular period variation of a pulsating star is an important contribution to the understanding of the nature and state of the stellar evolution. But is it possible to determine reliably the period behavior, only in the condition that the available observational data are regular and numerous enough, especially for establishing the mechanism that produces the changing period.

EH Lib was first reported as a variable star of AI Vel type in 1950. From then on, though more than 100 times of its light maximum had been accumulated up to 1980, many of them were determined in visual and photographic observations, which are not reliable enough. Both Mahdy & Szeidl (1980) and Jiang & Yang (1981) collected all the times of light maximum available in the literature and gave different results about the period variation. Therefore we decided to observe EH Lib once a time for every several years and carried out observations in 1981, 1985, 1992. All these observations were made by the 60 cm reflector at Xinglong station of Beijing Astronomical Observatory in the V-band of standard Johnson UBV system. The 13 new times of light maximum obtained are listed in Table 1. The columns 2–5 in Table 1 represent heliocentric epoch of maximum, cycle number, residuals with linear and parabolic ephemeris respectively. The column 6 is the weight for each data. Some of the light curves of the variable relative to the comparison star BD–0°2909 are shown in Figure 1.

In order to investigate how the period of EH Lib changes after we had obtained 13 new times of maximum for spanning another 12 years, we fitted all the times of maximum of photoelectric photometry [included the data taken from Hamdy (1985) and Joner (1986)] by using a linear formula and obtained

$$T_{max} = HJD\,2433438.6082{+}0\overset{d}{.}088413242E.$$

Figure 2 shows how the (O-C)$_L$ varies with cycle number E. After a further fitting with the least squares method we get

$$\begin{aligned}
&T_{max} = T_0 + P_0E + 0.5\beta E^2,\\
&T_0 = HJD\,2433438.6079 \pm 0.0002,\\
&P_0 = 0\overset{d}{.}088413251 \pm 4\times10^{-9},\\
&\beta = -1.05\times10^{-13} \pm 4.4\times10^{-14}\ \text{(days per cycle)}.
\end{aligned}$$

Since of rate the period change, β, is negative, it means the pulsation period is decreasing though the period change is small. This result, obtained by adding 29 new times of light maximum for a longer span of time, is consistent with that by Jiang & Yang (1981).

More accurate observations are encouraged in order to increase the time span and hence to get its accurate period variations.

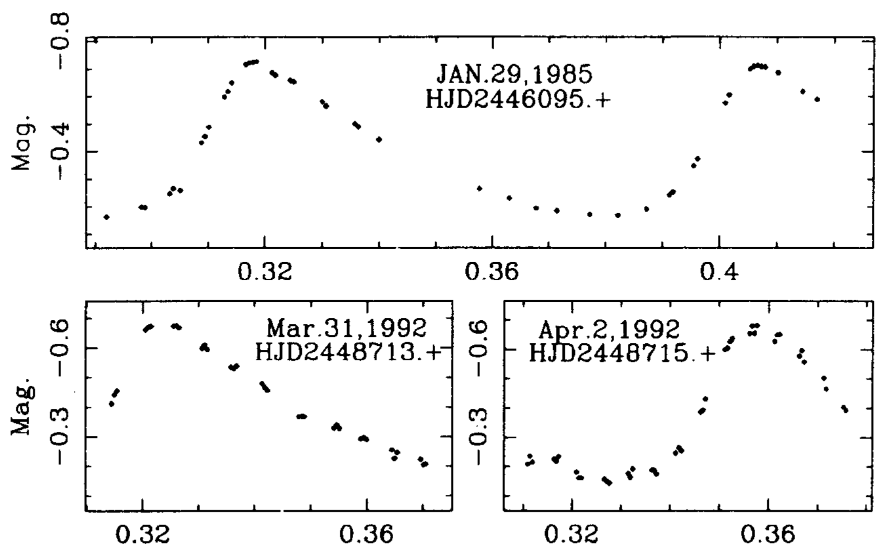

Fig.1 Light curve relative to comparison star

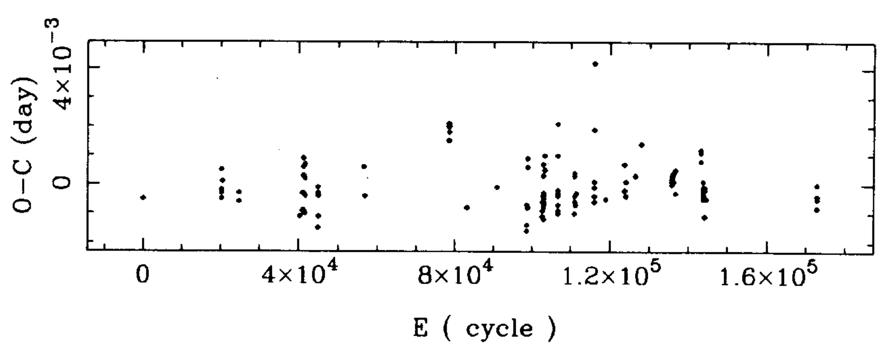

Fig.2 The O-C diagram

Table 1

New times of maximum and O-C residuals of EH Lib for linear and quadratic fits

No.	T_{max}	E	$(O\text{-}C)_L$	$(O\text{-}C)_Q$	W
1	44754.0900	127984.0	0.0014	0.0014	0.9
2	46094.3461	143143.0	0.0012	0.0013	1.0
3	46095.3183	143154.0	0.0008	0.0009	1.0
4	46095.4070	143155.0	0.0011	0.0012	1.0
5	46179.0437	144101.0	−0.0011	−0.0010	1.0
6	46179.1331	144102.0	−0.0001	0.0000	1.0
7	46179.2214	144103.0	−0.0002	−0.0001	1.0
8	46211.1383	144464.0	−0.0005	−0.0004	1.0
9	46211.2267	144465.0	−0.0005	−0.0004	1.0
10	48713.3220	172765.0	0.0000	0.00004	1.0
11	48714.2053	172775.0	−0.0008	−0.0004	1.0
12	48714.2941	172776.0	−0.0004	0.0000	1.0
13	48715.3550	172788.0	−0.0005	−0.0001	1.0

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NEW PHOTOELECTRIC PHOTOMETRY AND NEW TIMES OF LIGHT MAXIMUM OF AD CMi

AD CMi is a very important Delta Scuti type variable due to its 0.30 magnitude amplitude and stable light curve. Recently Jiang (1987) and Rodriguez et al. (1988) published numerous careful observations and suggested a rather different rate of increasing period variation. To check how its period varies with time, we observed it again from February to April, 1992 at Xinglong station of Beijing Astronomical Observatory by using the 60 cm reflector and its single channel photoelectric photometer in V-band. The comparison star was $BD+1°1938$ for Feb. 3, and $BD+1°1939$ for other dates. From these observations we derived 6 times of light maximum. Figure 1 only presents three of these light curves.

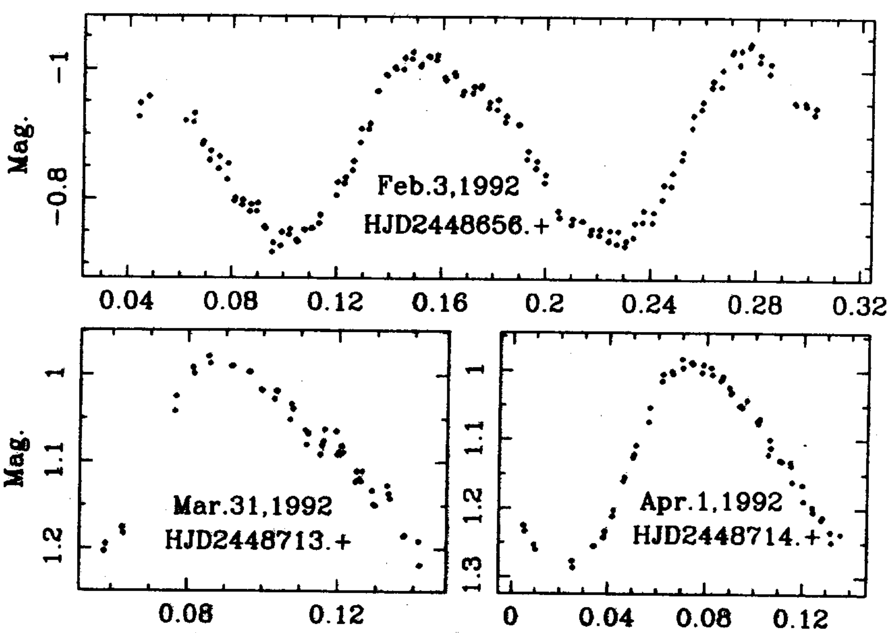

Fig.1 Light curve relative to comparison star

Table 1

Times of maximum and new O-C Residuals of AD CMi for linear and quadratic fits

No.	T_{max}	E	$(O\text{-}C)_L$	$(O\text{-}C)_Q$	W
1	36601.8228	0.0	0.0017	0.0004	1.0
2	36602.8066	8.0	0.0017	0.0004	1.0
3	36602.9296	9.0	0.0017	0.0004	1.0
4	36604.8971	25.0	0.0016	0.0003	1.0
5	36627.7700	211.0	0.0012	0.0000	1.0
6	36628.7538	219.0	0.0012	0.0000	1.0
7	36629.7373	227.0	0.0009	−0.0003	1.0
8	36629.8602	228.0	0.0009	−0.0004	1.0
9	36931.7620	2683.0	0.0003	−0.0005	1.0
10	36932.7470	2691.0	0.0015	0.0007	1.0
11	36934.8364	2708.0	0.0003	−0.0004	1.0
12	36969.7620	2992.0	0.0012	0.0005	1.0
13	41010.6985	35852.0	−0.0040	−0.0011	0.5
14	42429.4582	47389.0	−0.0010	0.0021	0.1
15	43182.4290	53512.0	−0.0030	−0.0001	2.0
16	43536.3488	56390.0	−0.0038	−0.0010	2.0
17	43536.4714	56391.0	−0.0042	−0.0014	2.0
18	44645.0877	65406.0	−0.0029	−0.0007	2.0
19	45766.3713	74524.0	−0.0007	0.0005	1.0
20	45768.3377	74540.0	−0.0019	−0.0007	1.0
21	45768.4606	74541.0	−0.0020	−0.0008	1.0
22	45771.4134	74565.0	−0.0006	0.0006	1.0
23	45772.3961	74573.0	−0.0017	−0.0005	1.0
24	45772.5187	74574.0	−0.0020	−0.0009	1.0
25	46417.3991	79818.0	0.0001	0.0006	0.5
26	46418.2596	79825.0	−0.0002	0.0003	2.0
27	46418.3825	79826.0	−0.0003	0.0002	2.0
28	46419.2434	79833.0	−0.0002	0.0003	2.0
29	46419.3663	79834.0	−0.0002	0.0002	2.0
30	46443.1010	80027.0	0.0004	0.0008	1.0
31	46443.2243	80028.0	0.0007	0.0011	2.0
32	46443.3470	80029.0	0.0004	0.0008	2.0
33	46444.0850	80035.0	0.0006	0.0010	1.0
34	46444.2082	80036.0	0.0008	0.0012	2.0
35	46444.3312	80037.0	0.0008	0.0012	2.0
36	48653.2017	97999.0	0.0035	0.0005	1.0
37	48656.1511	98023.0	0.0016	−0.0015	2.0
38	48656.2762	98024.0	0.0037	0.0006	2.0
39	48713.0884	98486.0	0.0017	−0.0015	1.0
40	48714.0724	98494.0	0.0019	−0.0013	1.0
41	48717.0242	98518.0	0.0023	−0.0009	1.0

In Table 1 we listed all the time of light maximum from the literature and our recent observations. A least squares linear solution of the ephemeris leads to the following formula:

$$T_{max} = HJD2436601.8211 + 0^{d}_{.}122974490E.$$
$$\pm 4 \qquad\qquad \pm 6$$

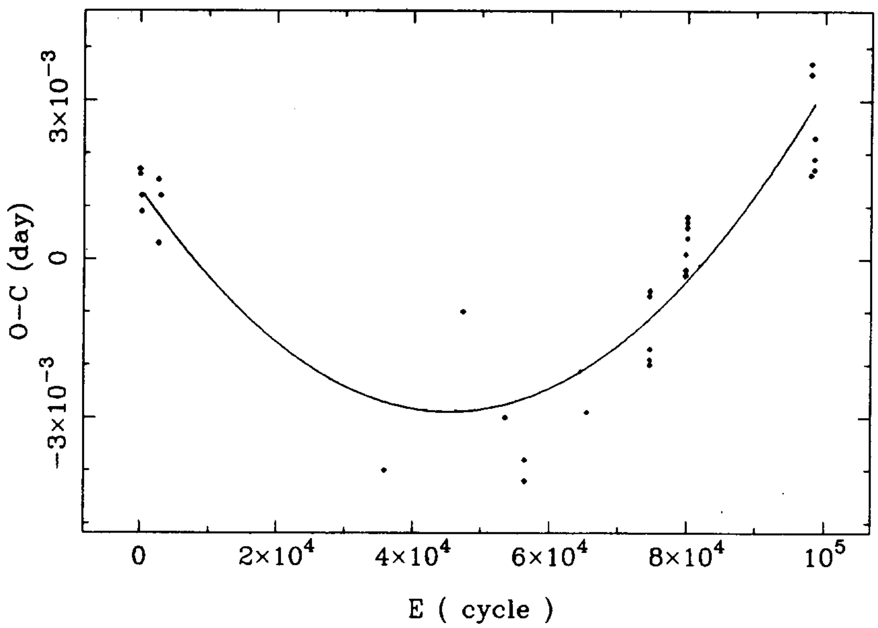

Fig.2 The O−C diagram

Figure 2 shows how the $(O-C)_L$ varies with cycle number E and also a parabolic curve of the least squares quadratic solution as follows:

$$T_{max} = HJD2436601.8224 + 0\overset{d}{.}12297429E + 2.19 \times 10^{-12}E^2.$$
$$\pm 2 \qquad\qquad \pm 1 \qquad\qquad \pm 11$$

Evidently, the quadratic fit is much better, so the period is clearly increasing with a rate of $(1.3 \pm 0.07) \times 10^{-8}$ days/year. On account of so small σ (only about 5% of the variation rate), our result is considerably reliable. But the very reliable observations in 1985 and 1986 could not be fitted by the curve well. We do not know why it is so. Therefore more observations are urgently needed to make clear the real situation about the period variation.

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PERIOD CHANGES IN HD79889

HD79889 was first reported as a variable star by Oja (1987), who estimated a period of $0^{\mathrm{d}}.0958697$ with a V amplitude of $0^{\mathrm{m}}.4$, and regarded it as a member of the high amplitude δ Scuti star class. Rodriguez et al. (1990) carried out observations in Strõmgren system and determined the physical parameters of the star. Liu et al. (1991) studied its period variations with observational data for a short span of time, pointed out that many observations need to be done in order to obtain more reliable results about the period changes.

Therefore we carried out further observations by the 60cm reflector at Xinglong station of Beijing Astronomical Observatory in the V-band of standard Johnson UBV system from Mar. 21 to Apr. 2, 1992, and obtained 6 new times of maximum listed in Table 1, where the columns 2-5 represent heliocentric epoch of maximum, cycle number, residuals with linear and parabolic ephemeris respectively, and the column 6 is the weight for each data. Light curves for three nights were constructed in Figure 1. Due to no evidence for variability of the comparison stars used by Oja (1987), C1 = HD79763, C2 = HD80079, we chose only HD80079 as the comparison star, with spectral type of A0, close to the A3 for HD79889 (Rodriguez et al., 1990).

We collected other 32 points of times of maximum about HD79889 (Liu et al., 1991) and altogether obtained 39 times of maximum for a longer span of time to study period variations.

Using a linear formula, maximum light occurs at the heliocentric epoch:

$$T_{max} = HJD2446506.0073 + 0^{\mathrm{d}}.09586951E.$$
$$\pm 1 \qquad\qquad \pm 1$$

Figure 2 shows how the $(\mathrm{O-C})_L$ varies with cycle number E. After a further fitting with the least squares method we get

$$\begin{aligned} T_{max} &= T_0 + P_0E + 0.5\beta E^2, \\ T_0 &= HJD2446506.0079 \pm 0.0002, \\ P_0 &= 0^{\mathrm{d}}.09586938 \pm 3 \times 10^{-8}, \\ \beta &= 1.1 \times 10^{-11} \pm 2 \times 10^{-12} (\text{days per cycle}). \end{aligned}$$

By fitting the $(\mathrm{O-C})_L$ with the least squares method, the long period variation accords with the parabola as shown in Figure 2. Since the rate of period change, β, is positive, this means that the pulsation period is increasing. This result, obtained by adding new times of maximum for a longer span of time, is inconsistent with that by Liu et al. (1991), one reason of which, may be, they had observational data for only a short span of time.

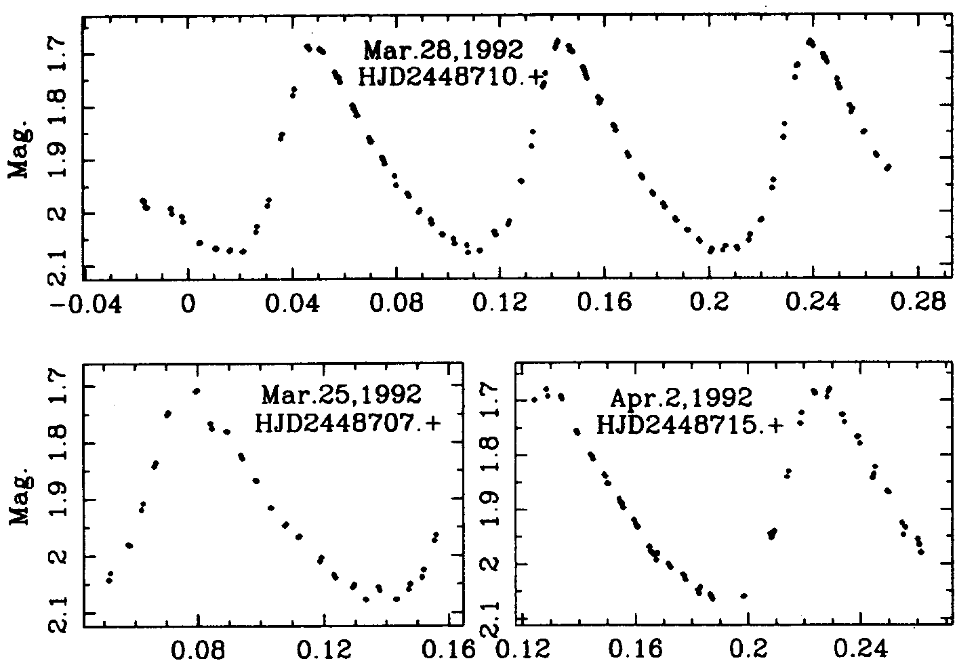

Fig.1 Light curve relative to comparison star

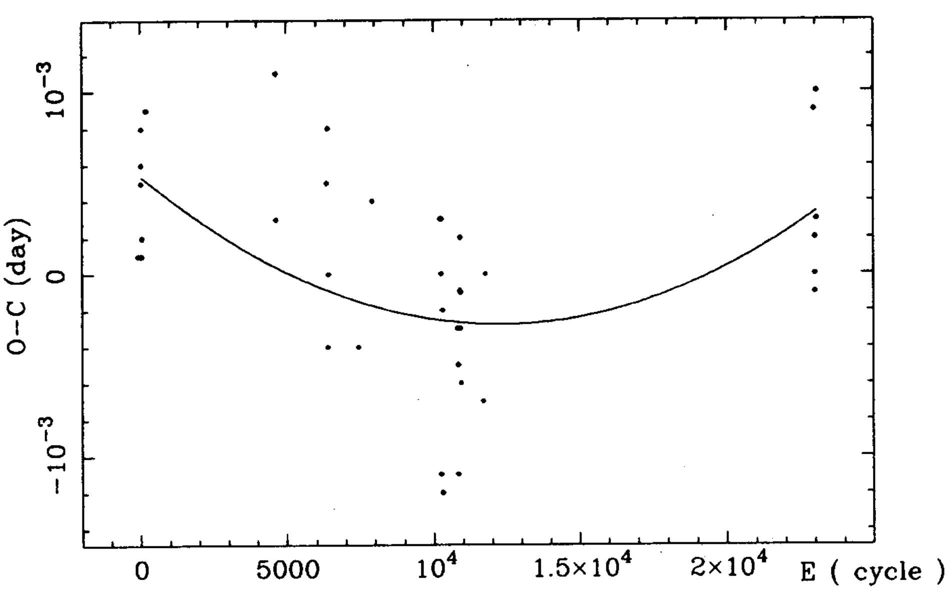

Fig. 2 The O–C diagram

Table 1

New times of maximum and O–C residuals of HD79889 for linear and quadratic fits

No.	T_{max}	E	$(O-C)_L$	$(O-C)_Q$	W
1	48707.0763	22959.0	0.0009	0.0006	0.8
2	48710.0473	22990.0	0.0000	−0.0004	1.0
3	48710.1434	22991.0	0.0002	−0.0001	1.0
4	48710.2390	22992.0	−0.0001	−0.0004	1.0
5	48715.1287	23043.0	0.0003	−0.0001	1.0
6	48715.2253	23044.0	0.0010	0.0007	1.0

Though we have added new times of maximum, which makes the observational data covering a longer time interval, and have obtained the result of increasing pulsation period, the star deserves further study and many observations for a much longer span of time are needed to confirm these results.

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NEW LIGHT CURVES AND TIMES OF MINIMUM OF SW LACERTAE

The W UMa system SW Lac (=BD+37°4717) has been well known for its variable period and light curves. Monitoring these changes is significant for one to understand the physical nature of the system.

In 1992 season, when the International Summer School of Young Astronomers (ISYA) of IAU was holding at Beijing, the star SW Lac was observed photoelectrically by the students of ISYA and colleagues of Beijing Observatory. The observations were carried out in BV colors by using a single channel photon counting photometer attached to the 60 cm reflector at Xinglong station of Beijing Observatory.

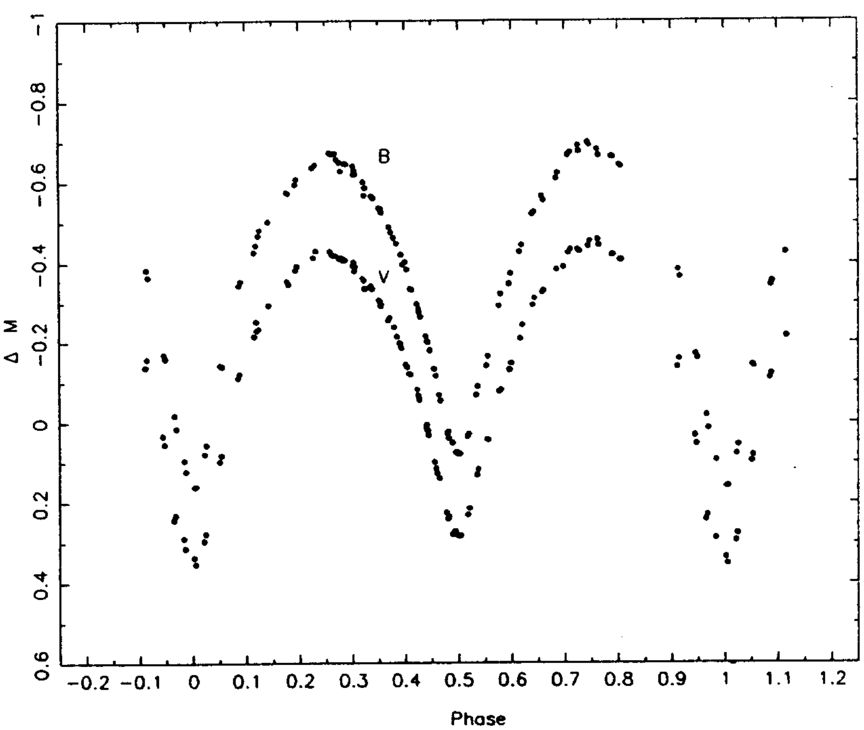

Figure 1. BV light curves of SW Lac in 1992

The stars BD+37°4710 and BD+37°4715 were adopted as comparison and check star, respectively.

A total of 109 photoelectric observations in each color were obtained on two nights from July 29 to 30, which covers completely an orbital cycle. The measurements have been corrected for differential extinction and transferred to the standard UBV system.

The new light curves as given in Figure 1 show the asymmetry with the Max. II brighter by about 0.02 mag than the Max. I in both B and V bands. It is just inverse to that of the 1986–1987 light curves obtained by Essam et al. (1992).

Table 1. New times of minima of SW Lac

J. D. Hel 244 0000+	filter	M. E.	Min.
8833.0909	V	±0.0003	I
8833.0917	B	0.0001	I
8834.2127	V	0.0002	II
8834.2130	B	0.0001	II

Table 1 gives the new times of minima determined with K – W method. Figure 2 is the O–C diagram of minima for the interval after 1985 (Faulkner 1986, Soliman et al. 1986, Pohl et al. 1987, Mullis et al. 1991, Essam et al. 1992). The observations of Soliman et al. (1986) represented by cross signs may be questionable when they are compared with the observations of exactly the same minima obtained by Essam et al. (1992). If the minima of Soliman were excluded from consideration, the period of SW Lac is nearly constant and close to P = 0.32071966 days. However the new period of SW Lac is about $0^s.052$ smaller than the period (= 0.32072026) found by Zhai and Lu (1989) within the time interval 1977–1986.

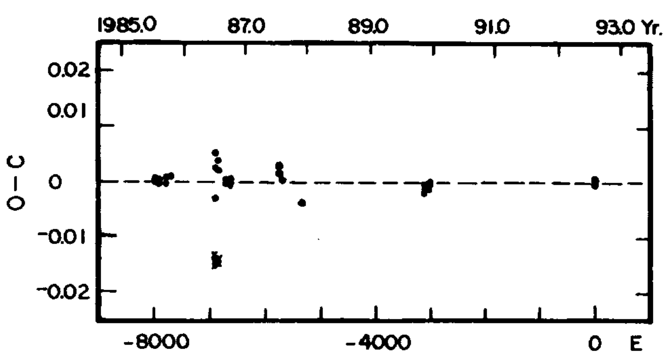

Figure 2. O–C diagram of minima of SW Lac during years 1985–1992

The following ephemeris can be used to predict the times of minima in near future:

$$Min.I = J.D.(hel)2448833.0910 + 0.32071966E$$

A further photometric analysis of the light curve is underway.

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A NEW SUPERGIANT VARIABLE: HD 186841 (B1 Ia)

A large number of supergiants show optical variations (see e.g. Maeder 1980, Percy & Welch 1983). Several of them have been observed with the 1-m and 50-cm telescopes of Konkoly Observatory in Piszkéstető in order to search for light variation. The variability of two supergiants has already been reported (Zsoldos 1990).

HD 186841 is a B1 supergiant in the Vul OB1 association (Humphreys 1978). It was observed earlier by Hiltner (1956), Thé & van Paradijs (1971) and Fernie (1983). These observations do not indicate any light variation except for the two $V-I$ and $V-R$ measurements of Fernie (1983, 1992) which differ by 0.1 mag.

HD 186841 was observed between 1983 and 1987 in the UBV-system. The observations were made relative to HD 186379 (V=6$^m_.$85; $B-V$=0$^m_.$62; $U-B$=0$^m_.$01) and BD+23°3759 (V=8$^m_.$77; $B-V$=0$^m_.$77; $U-B$=−0$^m_.$34) was the check star except for the first measurement in Table I where BD+23°3759 was the comparison. The observations are given in Table I. The average errors are 0$^m_.$007 in V, 0$^m_.$010 in $B-V$ and 0$^m_.$013 in $U-B$.

Table I
Observations of HD 186841

J.D. 2440000+	V	$B-V$	$U-B$
5536.459	7.890	0.817	−0.302
6159.590	7.900	0.796	−0.291
6181.526	7.906	0.805	−0.302
6196.539	7.924	0.819	−0.327
6315.378	7.862	0.801	−0.303
6678.368	7.839	0.824	−0.299
6985.432	7.898	0.788	−0.362

The light and colour curves of HD 186841 are plotted in Fig. 1. Though the observations listed in Table I are rather sporadic, they clearly show the variation in V. The $P-L$-relation of Maeder (1980) predicts a period of about 4 days ($\log T_{\rm eff}$ = 4.32 and $M_{\rm bol}$ = −8.6 was used (Peppel 1984)). There is, however, no possibility to check this prediction since the number of observations is low. The amplitude in V is about 0$^m_.$07 which is the expected value for a B supergiant (Maeder 1980). There are marked colour changes, too, though they do not necessarily follow the course of the variation in V.

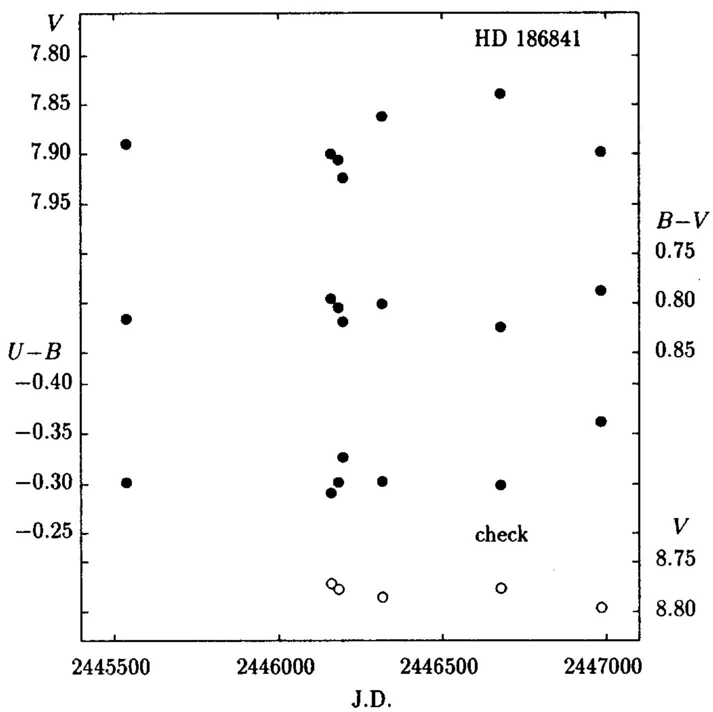

Figure 1. The light and colour curves of HD 186841

This research has made use of the Simbad database, operated at CDS, Strasbourg, France.

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THE PERIOD OF THE *S*–CEPHEID VARIABLE V950 Sco*

The variability of HD 159654≡NSV 9246≡BV 547≡V950 Sco was first reported by Strohmeier et al. (1964) and the preliminary elements of its light variation were obtained by Diethelm & Tjemkes (1984). The latter authors classified the star as a Cepheid variable with a period of 3.3825±0.015 d. On the basis of new and more accurate measurements, Mantegazza & Poretti (1992) determined the Fourier parameters of the V light curve and established that the star belongs to the class of the *s*–Cepheids, i.e. Cepheids which do not follow the Hertzsprung progression and pulsate in the first overtone mode. Owing to the large gap, it was not possible to relate the two available times of maximum light (HJD 2445540.43 and 2447991.097) and to refine the value of the period.

New measurements of V950 Sco were performed at the ESO–50 cm telescope in April and May 1992, following the same observing technique as described by Mantegazza & Poretti (1992); the same comparison star, i.e. HD 160069, was also used. The table lists the 13 new normal points collected in that way: they are not distributed in phase as well as the previous ones, but they allow us to reliably determine a new time of maximum at HJD 2448741.454, also confirmed by a much more precise time of minimum at HJD 2448743.247. No uncertainty is left as to the fact that the last two times of maxima are separated by 222 cycles: since we can estimate that the error on a single maximum determination is 0.03 d, we obtain a period of 3.3800±0.0002 d. A similar value, i.e. 3.38013±0.00005 d, was obtained by searching for the best light curve (including the first harmonic) fitting the data. In turn, this value for the period allows us to establish that 725 cycles separate the time of maximum reported by Diethelm & Tjemkes from our first one: the least–squares linear fit calculated by using the three available maxima gives

$$\text{Max.} = \text{HJD } 2447991.07 + 3.38019 \times E$$

* Based on observations collected at European Southern Observatory, La Silla, Chile

Hel. J.D.	V	Hel. J.D.	V
2448732.842	7.402	2448743.919	7.308
8734.707	7.100	8745.653	7.251
8735.823	7.334	8745.792	7.292
8735.920	7.357	8745.921	7.324
8736.814	7.390	8746.785	7.417
8736.917	7.371	8746.920	7.399
8739.855	7.416		

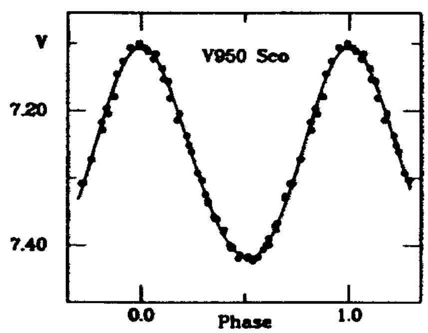

Figure 1

and an error of 0.00005 d on the period determination. Of course this linear ephemeris is valid only under the hypothesis that no abrupt change in the period has occurred since 1983.

As regards the Fourier parameters, the new measurements yield values that coincide (within the error bars) with those reported by Mantegazza & Poretti (1992). By processing all the 57 normal points we obtained the light curve shown in the figure; the resulting ϕ_{21} value, 3.70±0.14 rad, confirms that V950 Sco lies below the classical Hertzsprung progression in the $\phi_{21} - P$ plane.

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RAPID DECLINE OF FG SAGITTAE

FG Sge, the central star of the planetary nebula He 1–5 is a unique variable from both evolutionary and pulsational points of view (see e.g. Herbig & Boyarchuk 1968, Jurcsik & Szabados 1981, Iben 1984, Aikawa 1985). Since the end of the last century it had brightened and cooled to a red supergiant due to helium shell flash. In the 1980's its spectral type did not change any more. However, its classification fell between F6-7 I and K0-2 Ib (Kipper & Kipper 1989, Taranova 1986, Montesinos et al. 1990) as determined from observations in different spectral regions, because of the peculiar behaviour of the star.

While crossing the instability strip, FG Sge started to pulsate in the early sixties. The pulsation period of the variable increased in accordance with the spectral variation: it was about 10–20 days in 1962 and about 100 days in the eighties (Jurcsik & Szabados 1979, 1989). The enrichment of the surface s-process elements reported by Langer et al. (1974) strengthens the connection of the observed phenomena with the He shell flash episode of a post-AGB remnant.

In the last decade FG Sge seemed to stop its rapid evolution; no significant changes of its spectroscopic or photometric properties have been reported. All these phenomena fit well the evolutionary calculations of the thermal pulses showing the star moving along a flat loop on the HRD.

The photometric variation of FG Sge has been followed at Konkoly Observatory since 1988 using the 1-meter telescope at Piszkéstető Mountain Station and a $UBV(RI)_c$ thermoelectrically cooled, photon counting photometer. BD+19°4319 and BD+19°4310 were used as comparison stars.

The photometric behaviour of the star showed interesting changes in its pulsational properties in the last years (see Fig. 1). In the 1990 observing season the star developed an extremely long period, large amplitude pulsational cycle and since then only much shorter period, low amplitude oscillations have been detected. Since the end of July 1992 drastic dimming of the star with increasing speed has occurred. Papoušek (1992) reported a sharp decline of the variable on 4 September. FG Sge was as bright as $V=9^m_.2$ in August, whereas on 26 September it was already $V=12^m_.87$. During this interval the $U-B$, $B-V$ and the $V-R_c$ colour indices became bluer by about $1^m_.35$, $0^m_.80$, $0^m_.16$, respectively, and R_c-I_c reddened slightly. Recent IUE observations (González-Riestra et al. 1992) show similar decline of the UV flux as observed in the optical regions.

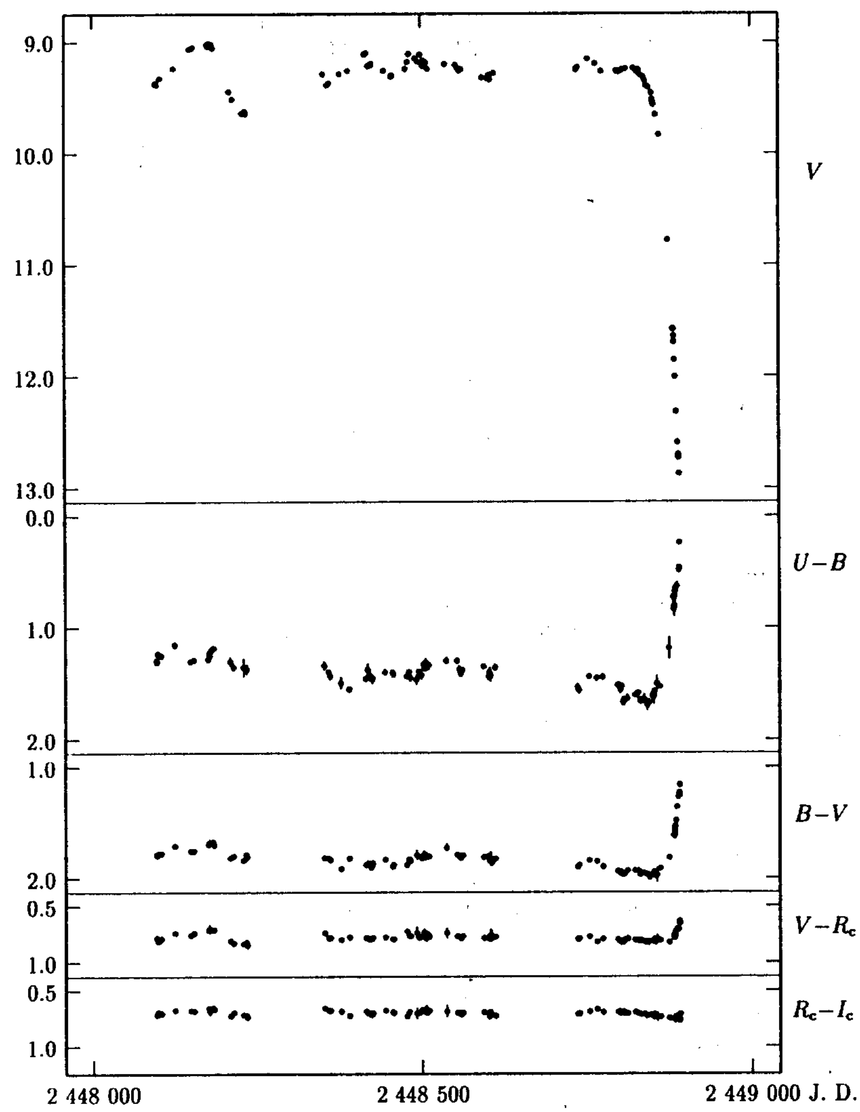

Figure 1. The V light curve and the colour curves of FG Sge in 1990, 1991 and 1992.

The timescale of the decline is several magnitudes shorter than predicted by evolution due to a thermal pulse (e.g. Schönberner 1983). However, pulsation is not included in evolutionary calculations. In the case of the post-AGB thermal flashes where the envelope mass is very small, the influence of the large amplitude pulsation on the evolutionary track of the star could be important. Moreover, the use of the OPAL opacity results in drastic shortening of the post-AGB evolutionary time scale as was shown by Kato and Hachisu (1992).

The pulsational period of FG Sge also shows a 4–5 year modulation superimposed on the steady increase (Jurcsik & Szabados 1989). The maximum phase of this cycle falls to the late eighties (see Fig. 1 in Jurcsik & Szabados 1989) and the observed amplitude and period of the pulsation in 1989–1990 was indeed very large as can be seen in Fig. 1 and Fig. 1 in Arkhipova et al. (1991). The length of the last definite pulsational cycle is longer than 140 days which shows further dilution of the supergiant atmosphere in the past few years, and the fact that subsequently the pulsation nearly disappeared also refers to important changes in the atmosphere. Therefore the possibility that the diluted envelope does not shine any more and we see the hot remnant again seems plausible. The fact that the $U-B$ and $B-V$ colour indices of the variable became significantly bluer while the red colour indices remained nearly constant — the hot remnant hardly radiating in the red region — is in agreement with this picture.

Further theoretical studies of post-AGB thermal pulses are needed to describe the present extraordinary phenomenon observed in FG Sagittae.

The photoelectric observations of FG Sge will be continued. According to the last observation, the star is already as faint as it was at the end of the last century. Knowledge of the full scale of the decline should also be relevant in clearing up the whole evolutionary history of FG Sagittae.

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THE SPECTROSCOPIC BINARITY OF MW CYGNI CONFIRMED

The Cepheid variable MW Cyg ($P=5^d954586$) was found by Szabados (1991) to be a new spectroscopic binary Cepheid candidate on the base of a considerable difference of γ-velocities among the observations published by Joy (1937), Struve (1945) and Barnes et al. (1988). Since July 1991 we have observed the star with the photoelectric radial velocity meter (CORAVEL type; Tokovinin, 1987). Our first 13 radial velocities for MW Cyg (obtained with the 1-m and 0.6-m telescopes in Simeiz and at Mt. Maidanak) have been included in the catalog of Cepheid radial velocities (Gorynya et al., 1992). We have compared these velocities with those analysed by Szabados and found reasonable agreement with the measurements by Barnes et al. (1988); the older radial velocities showed great scatter and seemed to us to be insufficient to judge on the star's binarity with certainty.

This summer we gathered 21 new radial velocity measurements of MW Cyg with the same equipment at the 1-m telescope of the Simeiz International Observatory (Crimea, the Ukraine). The Table contains the velocities measured in 1991–1992 with their internal r.m.s. error estimates. The Figure shows the radial velocity curve (dots–1991, crosses–1992) which definitely confirms the star's spectroscopic binarity. We have been able to mention the fact of the binarity confirmation in a note added in proof to our catalog (Gorynya et al., 1992).

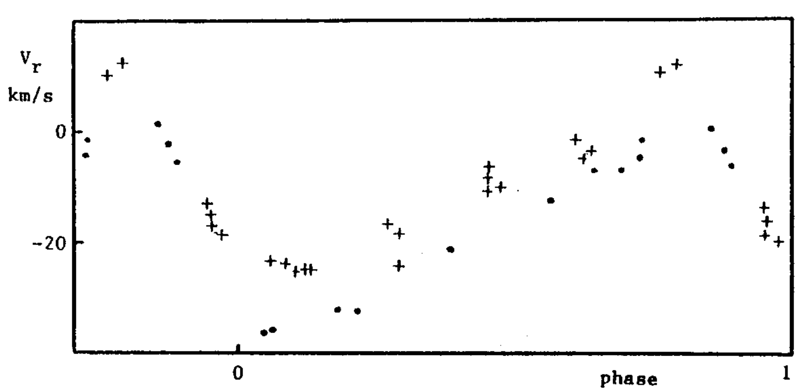

Figure 1. Radial velocity curve of MW Cyg from our observations.
Dots–1991, crosses–1992.

Table 1
Radial velocities of MW Cygni

HJD-2448000	V_r	σ	HJD-2448000	V_r	σ
453.506	−6.8	0.5	825.478	−25.0	0.5
495.428	−6.5	0.5	827.482	−7.7	0.4
496.450	1.4	0.7	830.498	−16.0	0.7
498.385	−32.2	0.6	831.466	−24.5	0.7
556.114	−2.2:	1.0	832.443	−16.9	0.8
557.184	−36.4	1.0	833.434	−7.8	0.5
558.156	−32.3	0.6	834.428	−1.9	0.5
559.148	−20.5	0.6	835.476	12.2	0.5
561.166	−4.1	0.8	846.352	−2.2	0.4
562.144	−5.5	0.8	848.437	−18.5	0.6
563.143	−36.2	0.9	849.407	−24.6	0.5
566.187	−12.2	0.4	850.380	−23.8	0.7
567.135	−1.2	0.9	851.339	−10.5	0.4
795.428	−23.4	0.6	854.313	−17.0	0.7
807.487	−24.1	0.7	856.318	−18.6	0.5
823.405	10.8	0.8	857.372	−9.5	0.4
824.488	−13.6	0.9	858.373	−3.5	0.6

We wish to thank Mr. O. Ugolnikov for his assistance during the observations. We are grateful to the administrations of the observatories for allocating observing time for this program and to the staff of the observatories for their help.

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ORBITAL LIGHT CURVE AND PARAMETERS OF X-RAY NOVA GS2023+338=V404 Cyg

The X-ray nova GS2023+338=V404 Cyg has been discovered as the best black hole candidate by recent spectroscopic investigations (Charles, 1991; Casares et al., 1992) with the orbital period $P = 6\overset{d}{.}47259 \pm 0\overset{d}{.}0009$ and mass function

$$f_v(\mathcal{M}) = \frac{\mathcal{M}_x^3 \sin^3 i}{(\mathcal{M}_x + \mathcal{M}_v)^2} = 6.26\mathcal{M}_\odot.$$

In this paper we present the optical orbital light curve of V404 Cyg in quiet stage (V = 19 ^{m}) that is in good agreement with the radial velocity curve (Casares et al., 1992) in the model of a close binary system.

Photometric observations have been obtained at the 50–cm telescope equipped with a television device in Crimean Astrophysical Observatory (Abramenko et al., 1983). During 5 nights 170 individual observations were obtained in 1991 when the system V404 Cygni was at quiet stage (V=19^m). The convolution of the average nightly values of the light of V404 Cyg with the spectroscopic orbital period (Casares et al., 1992) P=$6\overset{d}{.}47259$ and zero phase JD 2448477.353 (optical G-K star is in front) is presented in Figure 1. The mean light curve is given in Table 1. The magnitude differences refer to the brighter comparison star (No. 1 in Figure 2). A considerable ($\sim 0\overset{m}{.}3$) ellipticity effect of the optical G-K star is observed. Minima in the light of V404 Cyg are observed at the phases 0 and 0.5, which proves the fact that the radial velocity curve obtained for the G-K star by Casares et al. (1992) reflects the orbital motion of this star. So our photometric data proves correctness of the mass function determination for V404 Cyg $f_v(\mathcal{M}) = -6.26\mathcal{M}_\odot$ obtained by Charles (1991) and Casares et al. (1992). Because of the considerable ellipticity effect observed, we can conclude that the G-K star is the donor contributing the accreting matter onto the black hole.

Interpretation of the optical light curve of V404 Cyg in the framework of the standard model of X-ray binaries (Antokhina, 1988; Goncharsky et al., 1991) allows us to estimate the values of the parameters of V404 Cyg binary system: inclination of the orbital plane i = 45°–70°; mass ratio $q = \mathcal{M}_x/\mathcal{M}_v = 4.5 - 2.6$ accordingly; orbital separation of the components: a=46–39 $R_\odot$, mass of the black hole candidate $\mathcal{M}_x = 27 - 14\mathcal{M}_\odot$, mass of the visible star (which according to our results is a K0III star with the radius of about 12 $R_\odot$, but not G9V star) is $\mathcal{M}_v = 6 - 5\mathcal{M}_\odot$. The computer simulated model of V404 Cyg is presented in Figure 3. Our results confirm the conclusion of Charles (1991) and Casares et al. (1992) that V404 Cyg is the best black hole candidate.

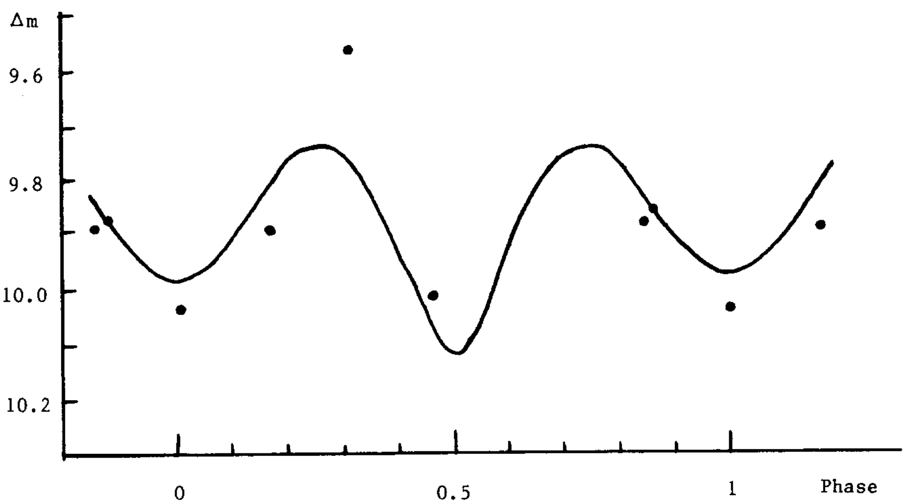

Figure 1. Observed (points) and theoretical (line) light curve of V404 Cyg. The theoretical curve corresponds to the mass ratio q=3 and inclination i=70°.

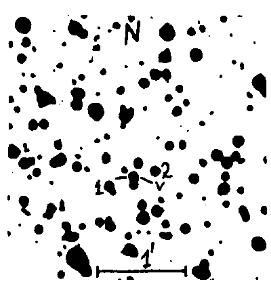

Figure 2. Finding chart for V404 Cyg. The magnitude of the star No. 1 is 19.65B, that of the star No. 2 is 20.4B.

Table I. Mean light curve of V404 Cyg.

Phase	Δm	σ	N
0.00	$0^m.04$	$0^m.02$	43
0.17	−0.11	0.09	11
0.31	−0.44	0.02	33
0.46	0.01	0.02	31
0.85	−0.12	0.03	9
0.86	−0.15	0.02	23

3

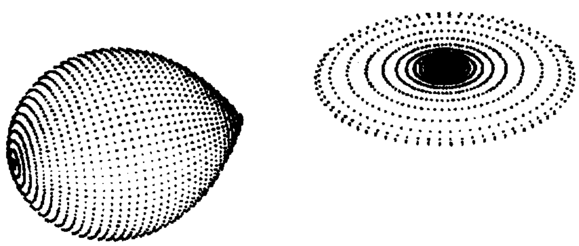

Figure 3. Computer simulated picture of the model for V404 Cyg

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NSV 07453 IS A NEW SHORT PERIOD CEPHEID OR A LONG PERIOD RR LYRAE STAR

The variability of NSV 07453=CSV 7263=WR 88 was discovered by Weber (1959). The author pointed out the brightness range $12^m\!.2$–$13^m\!.6$ and the possible type: Cepheid with the period of about 12^d.

The star was studied on 247 photographic plates obtained during J. D. 2418528–48394. The chart and the magnitudes of the comparison stars are given in Fig. 1 and Table 1 respectively. The analysis of the observations revealed that the brightness range is $12^m\!.5 - 13^m\!.8$ pg.

The following elements have been obtained:

$$\text{J. D. max} = 2441828.36 + 0^d\!.929172 \times E, \qquad M-m = 0^P\!.2.$$

The average light curve constructed with the new elements is given Fig.2. This period is unusual for such an amplitude. Note that the one–day alias of this period is equal to $13^d\!.3$. This value is very close to the period determined by Weber.

We compiled a sample list from GCSV (Kholopov, 1985) of the stars with the period $0^d\!.87 < P < 1^d\!.0$ and amplitudes $\geq 1^m$. The list of these stars is given in Table 2. These objects are sometimes called the BL Her stars, but BL Her itself has a slightly longer period ($P=1^d\!.307$). There exists a very similar object, FY Vir (Goranskij and Shugarov, 1979). FY Vir has $P=1^d\!.082$ and the range from $15^m\!.7$ to $17^m\!.3$ pg.

Additional high quality spectroscopic observations are desirable to classify this object correctly.

Table 1

Star	B_{pg}
a	$12^m\!.58$
b	13.07
c	13.59
d	14.15

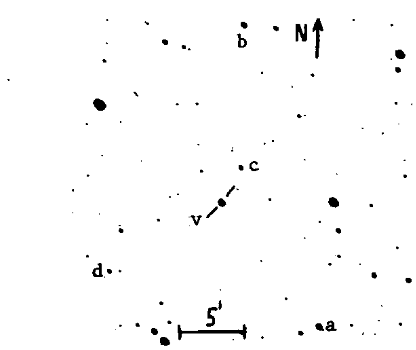

Fig.1

Table 2. Selected GCSV Stars (see text)

Name	Max−Min	Period	Type	M−m
V900 Aql	$14^m.6 - 16^m$	$0^d.874$	RR	20:
V524 Her	14.6 − 16.2	0.933	RRAB	11
V742 Cyg	15.9 − 16.7	0.93946	CWB	25
IZ Aps	13.7 − 14.7	0.9775	RRAB	20
EN Pav	15.2 − 16.4	0.9775	RRAB	20

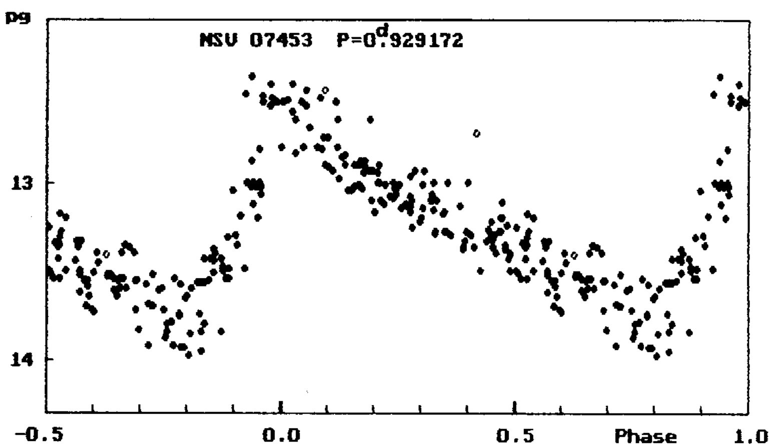

Fig. 2. The mean light curve of NSV 07453

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NSV 12006 – NO EVIDENCE FOR ERUPTIONS ON SONNEBERG PLATES

Solovyov (1949a) announced the discovery on a single plate of a possible Nova Aquilae 1949 (= NSV 12006). Several attempts have been made since then to check or disprove the reality of this image or to confirm the presence of an unusual object at the given position: Schaefer (1987), Wenzel (1987), Karnashov and Moskalenko (1988), Schaefer (1990), Greiner and Wenzel (1990). The last-mentioned authors eximaned Solovyov's original plate by a special microscopic technique using reflected light and came to the conclusion that the object shows all features of a real stellar image.

Therefore we inspected the location of the object on about 3000 suitable plates of the Sonneberg collection in order to possibly detect further eruptions. The material comprises 2520 plates of the sky patrol taken between 1926 and 1992 mainly by P. Ahnert, H. Huth, and B. Fuhrmann (exposure time 30 to 60 minutes, threshold 12^m to $14\overset{m}{.}5$) and 474 plates centered at δ Aql and exposed at the astrographs with the dimensions 17/120 cm, 40/190 cm, and 40/160 cm by C. Hoffmeister, R. Brandt, G. Richter et al. in the years 1928 to 1992, with major gaps (exposure time as above, threshold 15^m to $17\overset{m}{.}5$).

No eruption could be discovered.

There remains, however, some obscurity concerning the position: 1. The diameter of the image on the Dushanbe plate is about 40". 2. Karnashov and Moskalenko (l. c.) gave an accuracy of their co–ordinates of ±1". 3. These co–ordinates exactly equal those of Solovyov (1949b), despite a difference of the equinoxes of 1 year (1950.0 and 1949.0).

About 10" to the west of Karnashov and Moskalenko's position a star of $16\overset{m}{.}5$ is to be seen on the POSS and on numerous astrographic plates of ours. To this star (marked with two strokes in our map), which lies well within the boundaries of Solovyov's image (circle in the map), the authors just quoted did not pay attention, probably because it is situated outside their error box. Nevertheless, as a precaution we checked it, but could not find any conspicuous variability.

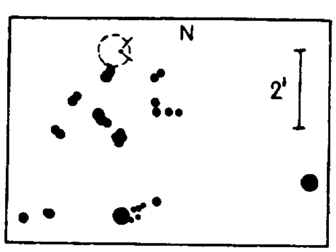

Figure 1

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UBV PHOTOMETRY OF THE SYMBIOTIC BINARY BF CYGNI

The light-curve (LC) of the symbiotic star BF Cygni has been studied since 1890 photographically (e.g. Jacchia, 1941). It is characterized by several outbursts of 2-3 mag amplitude accompanied by a gradual decrease of the star's brightness, from $m_{pg} \sim 10$ to $m_{pg} \sim 11$, and by long period variations, $\Delta m_{pg} \sim 1$, corresponding to an eclipse-like effect. Recent observations were collected by Hric et al. (1991) and Skopal et al. (1992).

The last increase of the brightness became at the middle of 1987 ($m_v \sim 10.6$). After a gradual decrease up to $m_v \sim 12.2$ at the beginning of 1989, the star's brightness grew abruptly to $m_v \sim 9.8$ at the end of 1989. Our photometric observations of BF Cyg have been made during this recent outburst phase, from November 1989. The measuring were carried out in the standard UBV system using a one-channel photoelectric photometer installed in the Cassegrain focus of the 0.6/7.5 m reflector of the Skalnaté Pleso and Stará Lesná (near Tatranská Lomnica) Observatories, operating on the principle of the method of pulse counting. The stars HD 183650 (SAO 68384), $V = 6.96$, $B - V = 0.71$, $U - B = 0.34$, Sp G5 and BD+30°3594, $V = 9.54$, $B - V = 1.20$, $U - B = 1.70$ were used as comparisons. Several observations were obtained within the framework of an international campaign of long-term observations of symbiotic stars (Hric et al. 1991; Skopal et al. 1992).

Figure 1 shows the UBV photometry of BF Cyg. During the whole observational period BF Cyg was brightest in the U filter. This fact reflects a strong interaction in the binary. In October 1990 the star's brightness reached the maximum 9.35 in the U filter, but during the period June – August, 1991 the brightness faded by about 1.8 mag in all filters (U$\sim$ 11.2, B $\sim$ 12.0, V $\sim$ 11.5) and in September 1991 sudden brightening by about 0.9 mag was observed. Such behaviour of the LC reflects an eclipse-like effect. Compiling our V measurements with the visual magnitude estimations, the middle of this primary minimum can be derived at JD 2448444 $\pm$ 1.1 days by the second degree polynomial least squares fit. Behaviour of the UBV light curves around JD 2448130 shows a possible existence of a secondary eclipse (hot component between the cool component and observer). Their middle at JD 2448129.4 $\pm$ 3.4 was determined by the same method as for the primary minimum. According to Heintz (1978), the position of the secondary, t_s, and the primary, t_p, minima gives the condition which must be satisfied by the orbital eccentricity e, periastron angle ω and orbital period P of binary as

$$\pi(t_s - t_p - P/2)/P = 2\,e\cos\omega \qquad (1)$$

Orbital period $P = 757$ days (e.g. Pučinskas 1970), $t_s = 2448886.4$ and $t_p =$ JD 2448444 imply

$$e\,\cos\omega = 0.133 \qquad (2)$$

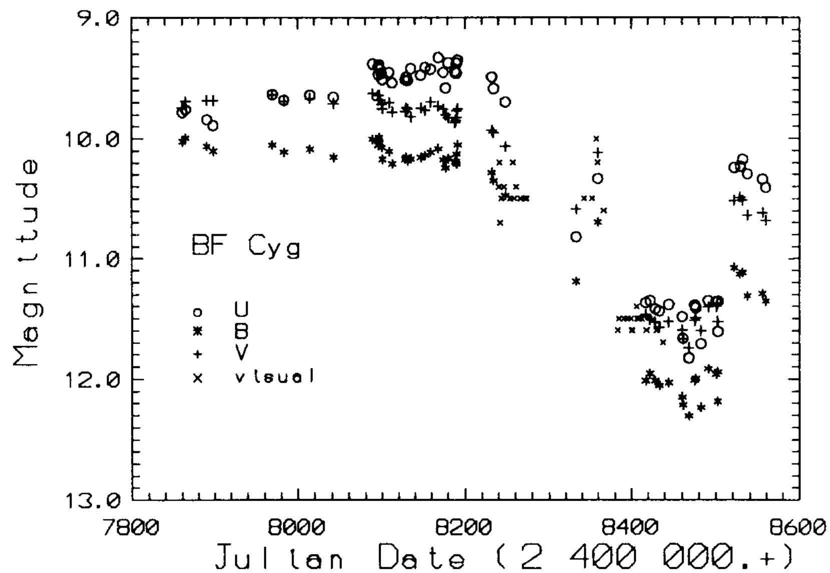

Figure 1: Light curves for BF Cygni according to the data published by Hric et al. (1991) and Skopal et al. (1992)

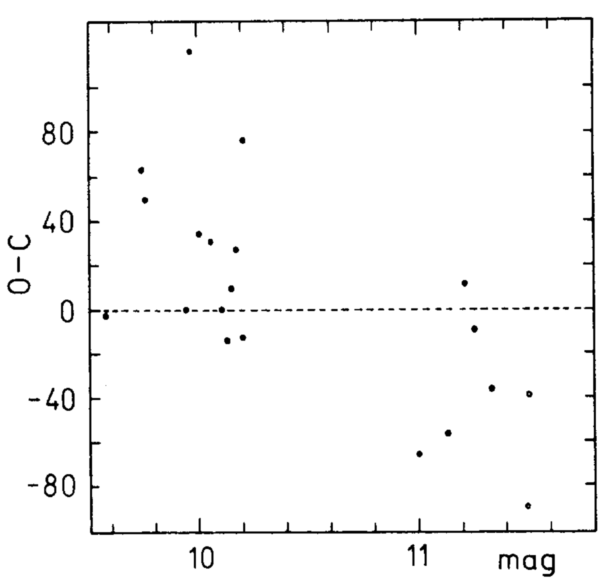

Figure 2: Relationship between the O-C values and the star's brightness (see text in detail). The minima were taken from Jacchia (1941) - full circles, and determined from the data published by Kudashkina (1988) - open circles

This value agrees with the orbit geometry derived by Mikolajewska et al. (1989) from radial velocities of the emission HeI lines ($e = 0.23 \pm 0.10$, $\omega = 60^\circ \pm 27^\circ$). Position of our last primary minimum indicates new average value of the orbital period of 759 days. Jacchia (1941) and Pučinskas (1970) showed considerable real differences, up to 100 days, between observed and computed minima positions. From this point of view it is very problematical to determine a more accurate orbital period (if such one exists at all) of this binary system. Generally, this irregularity results from interaction in the system. For example, if we take the maximum of the star's brightness before and after the minimum observed as a parameter characterising interaction in the system, we can obtain the relationship between this parameter and the $O - C$ value (Fig. 2). The times of the primary minima were taken from Jacchia (1941) and the $O - C$ values were determined according to the ephemeris

$$JD_{\mathrm{Min}} = 2\,415\,035.7 + 759.3\,E \tag{3}$$

derived from the first well defined minimum, at JD 2 415 795 in Jacchia (1941) and average value of the orbital period derived from this and recent minimum. This fact means that during the maxima of the activity the period is larger than during the quiescence. Analogical problem of the orbital period determination is known, for example, in the symbiotic star AG Peg, and/or the symbiotic star V 1329 Cyg exhibited eclipses with 950 day separation (Grygar et al. 1979) during the quiescent phase ($m_{\mathrm{pg}} \sim 15$), but during the outburst phase ($m_{\mathrm{pg}}^{\mathrm{max}} \sim 12$ to 14) the orbital period became longer, about 964 days (Nussbaumer et al. 1986). Detailed analysis of BF Cyg LC can lead us to solving this crucial problem.

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NO CHROMOSPHERIC ACTIVITY SEEN IN THE VERY ECCENTRIC DOUBLE-LINED BINARY Gliese 586A

Two recent orbit determinations found Gliese 586A (= HD 137763, K1V + M0V, P = 890 days, $V = 6.8$ mag) to be a double-lined spectroscopic binary with an orbital eccentricity of 0.975 (Tokovinin 1991, Duquennoy et al. 1992). This is the highest eccentricity yet found among spectroscopic binaries. Due to the relatively long orbital period of 890 days the system still remains well detached at periastron passage but the two stars pass each other at a distance of only 10 $R_\odot$ (Duquennoy et al. 1992). As was also noted by the latter authors, the distance at periastron would be equivalent to that of a circular orbit with a period of 3.5 days. Late-type stars in a binary system with such a short period could be suspected to show chromospheric emission from either of the two components due to magnetic activity. We might even have the rare possibility to explore the switching on (and off) of a stellar dynamo when the two components are closest assuming that some sort of differential rotation couples the dynamo action to tidal forces. Glebocki & Stawikowski (1977, 1988) found some relation between chromospheric emissions and orbital parameters for late-type giants and suggested that tidal forces are somehow responsible for the enhanced chromospheric activity. Schrijver & Zwaan (1991) argued that in a synchronized close binary the axis for rotational effects is through the center of gravity of the binary system and thereby affects the stellar dynamo in such a way to produce enhanced magnetic activity.

Consequently we obtained a single high-resolution spectrum of the Ca II H and K lines of Gliese 586A to search for possible chromospheric emission lines. We used the 0.9-m coudé feed telescope at Kitt Peak National Observatory equipped with camera 5 and grating A and a 800-pixel TI CCD to obtain an effective wavelength resolution of 0.15 Å. *No* significant Ca II H and K emission is obvious from this spectrum (Fig. 1) which was taken at orbital phase 0.844 (HJD 2448718.417). However, we note that the periastron passage (phase 0.000) occurs within two days and was not covered by our observation. We emphasize the importance of further high-resolution monitoring of Gliese 586A especially around periastron passage (the next periastron passage will take place at HJD 2449746.782 = UT 1995 January 28 according to the elements of Duquennoy et al.).

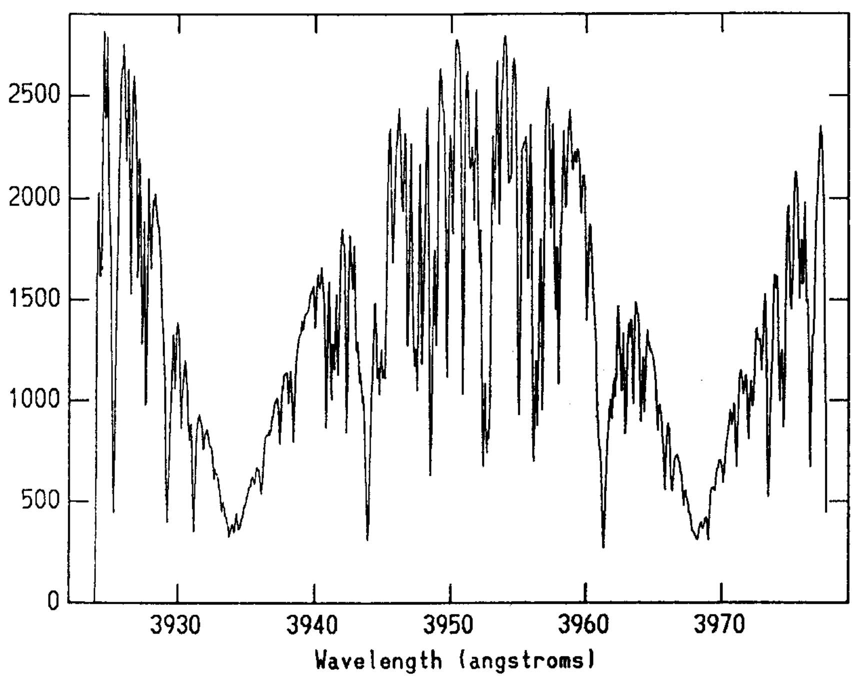

Fig. 1: A high-resolution spectrum of Gliese 586A centered at Ca II H and K. No significant chromospheric emission is detected.

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THE STELLAR SYSTEM AW Cam

The star AW Cam, originally named BV 412, was discovered as a variable star by Strohmeier, Knigge and Ott (1963). The Cracovian Annual for 1992 describes it as a 8.0 magnitude star, with minima of amplitude $0^m.35$ and $0^m.06$ respectively.

Photometrically and spectroscopically it is considered that the principal minimum is a transit. The spectral classes of the two components are A0V and F2. The bigger star is also the hotter.

The Seventh Catalogue of the Orbital Elements of Spectroscopic Binary Systems presents its orbit as an elliptical one with:

$$\omega = 10° \text{ and } e = 0.12.$$

This star was introduced in our observational program because until now the light curve determination has been very poor and the elements computed are not very accurate.

Our observations are performed at Bucharest Observatory with a 50cm Cassegrain telescope using an EMI 9502B photomultiplier. The numbers of the observational points are 371 in U, 372 in B and 403 in V filters respectively.

Using the ephemeris:

$$P = 2438738^d.4522 + 0^d.77134 68 \times E$$

two minima were calculated. The O−C values obtained are respectively:

Julian Date	O−C	Min	Filter
2445408.2819	−0.0061	I	V
2447972.2460	+0.0013	I	V

We used a Wood model for the determination of the elements the system. Because the observational scatter is large, we have used an "alternate directions" method for light curve solution with six steps in computation. In the first two steps, we try to obtain solutions using two different routes to perform the differential corrections on the mathematical hypersurface

$$(i, \omega, e, a_1, k, u_2, T_2)$$

of the solution:

$$[(i, a_1, k, T_2)o(\omega, e)] \text{ and } [(\omega, e)o(i, a_1, k, T_2)],$$

respectively, for calculating the influence of the pair (ω, e). The values obtained by two different routes are partly different from those given by Batten et al. (1978).

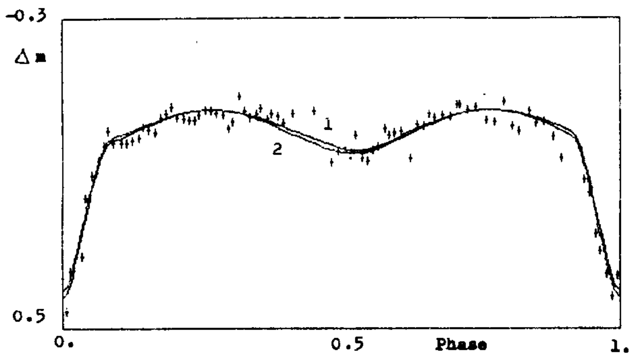

Figure 1. AW Cam B filter; lines–model 1, 2; pluses–obs. points

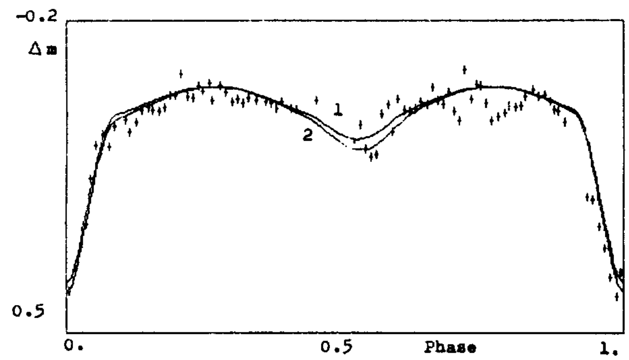

Figure 2. AW Cam V filter; lines–model 1, 2; pluses– obs. points

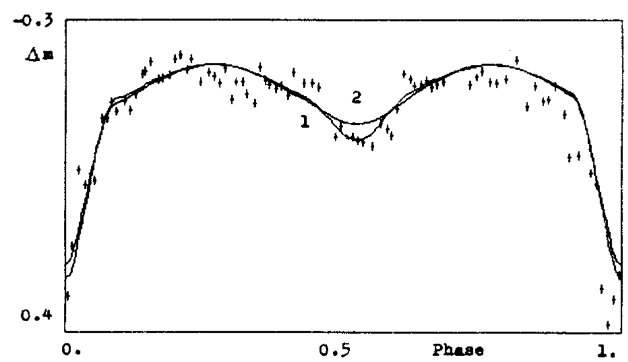

Figure 3. AW Cam U filter; lines– model 1, 2; pluses–obs. points

The next steps were taken by an alternation of

$$[(u_2, T_2), (i, a_1, k, T_2)]$$ calculations.

During this process two "relative minima" were found, with practically the same $\Sigma(O-C)^2 = 0.05$ values. The larger scatter of the observed light curve does not permit us to discriminate better between these two solutions. The results for the two minima in B filter are:

ELEMENT	SOLUTION 1 B	SOLUTION 2 B
i	78.3	78.2
$e\sin\omega$	0.071	0.095
$e\cos\omega$	0.040	0.046
u_1	0.6	0.6
u_2	0.3	0.28
a_1	0.36	0.376
k	0.55	0.537
β_1	0.25	0.25
β_2	0.25	0.25
T_1	9520	9520
T_2	5030	4687
q	0.5	0.5
$\Sigma(O-C)^2$	0.053	0.052

The observational UBV data will be published in Romanian Astronomical Journal.

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Hα SPECTROSCOPY OF NOVA CYGNI 1992

Nova Cygni 1992 was discovered by Collins (1992). Photometric observations by many observers indicate that the maximum brightness occurred at around February 22 with a visual magnitude of about 4.3, the brightest among the novae observed in the last 10 years. The light declined slowly and t_3 found to be about 47 days (Kidger 1992). The strong neon lines in IUE and optical spectra reveal that it is a new member of the "slow" ONeMg class of novae (Austin and Starrfield, 1992) like QU Vul (Gehrz et al., 1985, Bergner et al., 1988).

In coordination with IUE observation, two CCD Hα spectra of Nova Cyg 1992 were obtained by us with the 2.16−m telescope at the Xinglong station of Beijing Observatory. A fiber−fed Cassegrain spectograph was used together with a 576×384 CCD detector. The reciprocal dispersion of the spectrum is 50 Å/mm, corresponding to 1.15 Å per pixel. The two spectra were exposed on May 8.83 and 9.85 UT, respectively. The Hα lines on them show nearly the same structure.

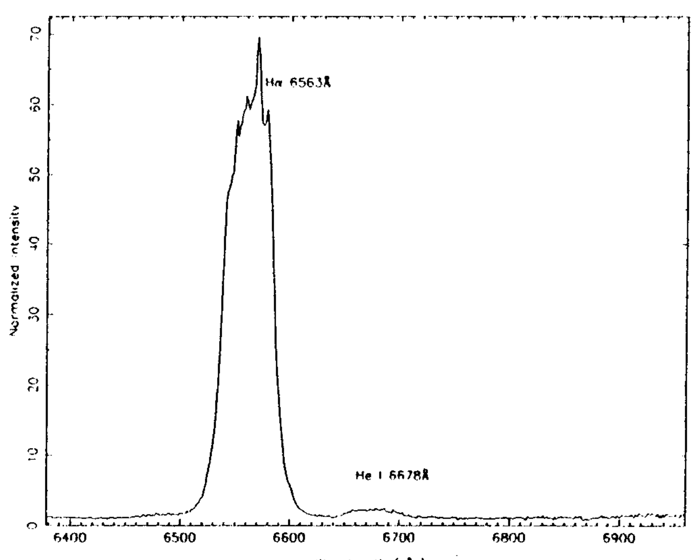

Figure 1. CCD Hα spectrum of Nova Cygni 1992 on 1992 May 8.83 UT.

Figure 1 displays the spectrum on May 8.83 UT, with strong Hα and apparently HeI 6678 Å also in emission. The Hα profile has a very complex structure with several peaks. Through multiple fitting six Gaussian profiles are found with five in emission and one in absorption as shown in Figure 2. The line identification of the Gaussian profiles as well as their radial velocities are listed in Table 1.

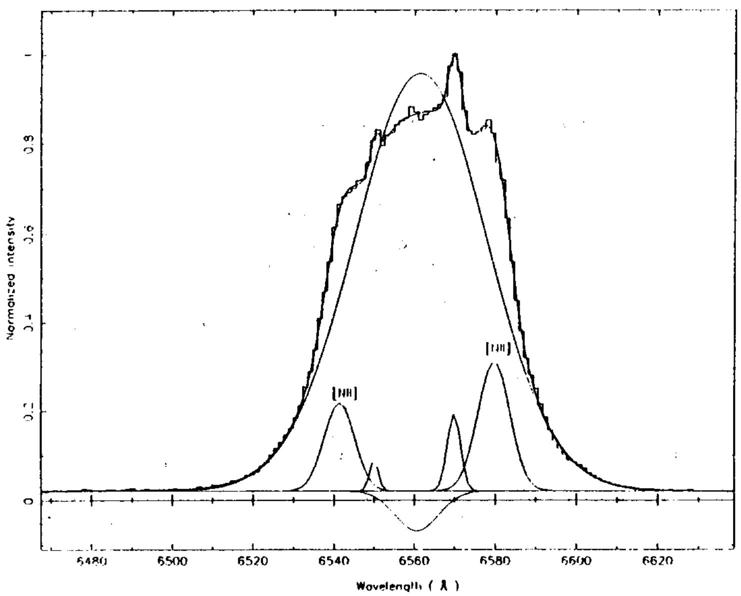

Figure 2. Multiple Gaussian fitting of the Hα profile.

Table 1

λ (Å)	Identification	Δ λ (Å)	V_r(km/sec)
6541.3	[NII] 6548.1 Å	−6.8	−312
6550.0	Hα(?)	(−12.8)	(−585)
6560.7	Hα 6562.8 Å	−2.1	−96
6561.4	Hα 6562.8 Å	−1.4	−64
6569.9	Hα (?)	(+7.1)	(+325)
6579.7	[NII] 6583.4 Å	−3.7	−170

Two strong [NII] emission lines were observed to be blended with Hα. Their radial velocities are found to be −312 and −170 km/s, respectively.

The large difference in the radial velocities could be caused by the emissions from distinct envelopes with different expansion velocities. The appearance of the forbidden [NII] lines confirms that the nova had already entered the nebular stage as reported by Austin and Starrfield (1992), as well as Rafanelli and Rosino (1992). It is interesting to notice that the nova experienced an obvious brightening by $\Delta B \sim 0.20$ from May 2 to 9. (Hanzl et al., 1992, Dintinjana et al., 1992) and then resumed its decline in brightness but more slowly than before.

The two unidentified features at 6550.0 and 6569.9 Å could both be shifted Hα lines caused by the re-emission from the inner parts of a geometrically thick but optically thin dust disc. Their high radial velocities may be somehow connected with the spin of the disc, but the huge difference between them is an open question.

The Hα emission profile exhibits no obvious P Cyg structure appear but there is a weak central absorption instead, which is typical for a star with expanding gas envelope. More Hα spectra were obtained after this observation. Their careful analysis will help us to understand better the nature and evolution of Hα emission during the outburst of Nova Cyg 1992.

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PHOTOELECTRIC UBV OBSERVATIONS OF THE s-CEPHEID V1334 Cyg

V1334 Cyg, a small amplitude Cepheid has been known as a spectroscopic binary. The close companion to V1334 Cyg is a B−type star (B4 V according to Usenko's (1990) photometry; B8 III from IUE spectra (Henriksson, 1982) and B5−B8 V from TD1 spectra (Parsons, 1981)), with more reliable value of the orbital period about 1240^d (Szabados, 1991).

Photoelectric observations of V1334 Cyg have been performed in October 1988 at Abastumany Astrophysical Observatory (Georgian Academy of Sciences). Observations were made in the UBV filters with the 48−cm reflector AZT−14. HR 8169 (V=6.056; U−V=0.199; B−V=0.063 (Arellano Ferro, 1984)) was used as the comparison star.

The V, U−V and B−V data are listed in Table 1 together with the phases calculated with the elements according to Arellano Ferro (1984):

$$\mathrm{Epoch+Phase=(HJD-2444863.767)/3^{d}\!.33279}$$

The uncertainties are $0^m\!.010$, $0^m\!.020$, and $0^m\!.010$ in V, U−V and B−V respectively.

The light and colour curves of V1334 Cyg are plotted in Figure 1. The new data are denoted with dots. For comparison purposes data obtained by Millis (1969) (squares), Szabados (1977) (crosses), Arellano Ferro (1984) (triangles) are also shown. For all these data the phases have been computed from Arellano Ferro (1984) too. The colour curves U−V and B−V from various authors differ from each other completely, this is especially noticeable for the recent B−V data. Moreover, the scattering of the data supposes some amplitude variations for this interesting s−Cepheid.

Table 1
Photoelectric observations of V1334 Cyg

HJD 2440000.+	V	U−V	B−V	Phase	HJD 2440000.+	V	U−V	B−V	Phase
7436.2766	5.834	0.625	0.340	0.879	7441.4705	5.905	0.672	0.330	0.437
7436.2839	5.845	0.609	0.303	0.881	7444.2258	5.988	0.652	0.369	0.264
7436.3111	5.841	0.638	0.316	0.889	7445.2334	5.948	0.650:	0.320:	0.566
7436.3146	5.853	0.632	0.325	0.890	7450.3086	5.908	0.644	0.327	0.089
7436.3330	5.858	0.624	0.279	0.895	7450.3161	5.908	0.623	0.331	0.091
7436.3476	5.863	0.636	0.244	0.900	7450.3305	5.903	0.628	0.315	0.096
7436.3587	5.864	0.614	0.310	0.903	7450.3379	5.910	0.631	0.311	0.098
7436.3630	5.852	0.617	0.313	0.905	7450.3492	5.903	0.652	0.312	0.101
7436.3969	5.815	0.651	0.360	0.915	7450.3578	5.902	0.642	0.331	0.104
7436.4625	5.831	0.630	0.300	0.935	7450.3655	5.905	0.591	0.332	0.106
7436.4634	5.843	0.616	0.288	0.936	7451.2482	5.998	0.669	0.365	0.371
7436.4706	5.855	0.602	0.301	0.937	7451.2544	6.003	0.671	0.355	0.373
7436.5098	5.857	0.597	0.319	0.942	7452.3398	5.939	0.638	0.322	0.698
7441.4009	5.913	0.658	0.345	0.416	7452.3641	5.935	0.622	0.308	0.706
7441.4578	5.907	0.679	0.332	0.433	7452.3712	5.928	0.644	0.342	0.708

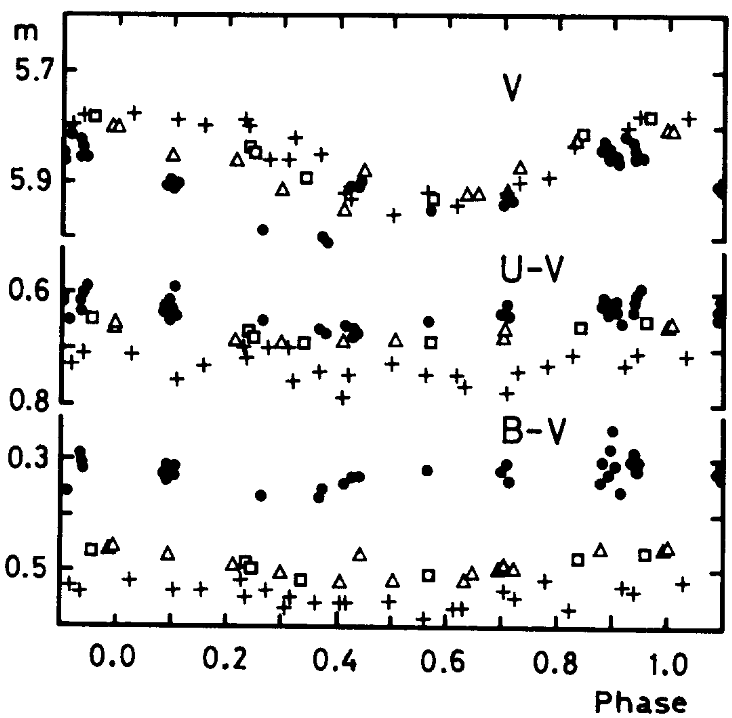

Figure 1. Light and colour variations of V1334 Cyg during October 1988, (see the comments in the text)

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GSC 5198.00659, THE NEW VARIABLE IN AQUARIUS IS A W UMA SYSTEM

During a test phase run with the recently completed high speed photocounting double beam photometer at the 1 m Cassegrain/Nasmyth telescope of the Hoher List Observatory, we observed the new variable in Aquarius GSC 5198.00659 (RA 2000=$21^h21^m24^s.9$; Dec. 2000=$-3°09'38''.4$) on 8 nights in August/September, 1992 in V-spectral range. The variability of this object was recently announced by R. Gil Hutton in IBVS No. 3723.

As the double beam photometer allows the simultaneous observations of two stars only within the telescope field of 20 arcmin, we had to use another comparison star than those given by Hutton namely SAO145329: RA 2000= $21^h21^m46^s$, Dec. 2000=$-3°11'58''$. The measurements were carried out with a time resolution of 1 sec in blocks of 5 to 10 min length, with relevant 2–3 min interruptions for sky–, dark– and lightsource observations and recentering the objects. Due to the northern latitude of the Hoher List Observatory the variable could be observed no longer than 5–6 hours per night.

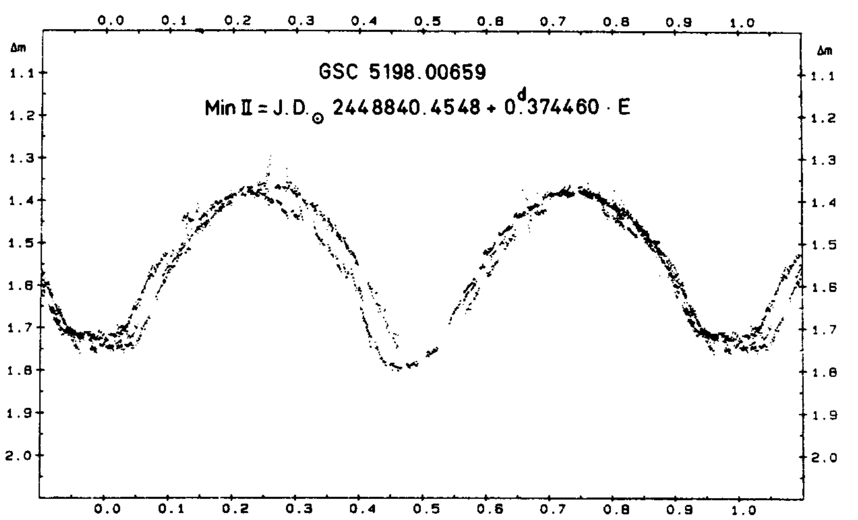

Fig.1: The composite V–lightcurve of GSC 5198.00659 obtained on the nights August 5, 6, 7, 8, 27 and September 16 and 17, 1992. Each point is the average of 30 one second integrations.

Table I

JD_{Hel}		O−C	Weight
2440000+			
	Min I		
8842.5161::		+0.0046	1
8883.3281		−0.0065	3
	Min II		
8840.4544		−0.0011	3
8841.5749:		−0.0088	1
8843.4507		+0.0005	3
8850.5641::		−0.0031	1
8862.5514		+0.0091	3
8882.3932		−0.0032	3
8883.5173		−0.0013	3

The observations yield a lightcurve of W UMa type (Fig.1), having a total 'occultation' minimum (Min II) with an amplitude of about 0.37 mag. Its form and depth was changing within 40 days by 0.04 mag. The 'transit' minimum (Min I) was well observed up to now only once, and has a depth of about 0.40 mag.

Light curve variations outside the eclipces, especially before and after Min I and after Min II of about 0.05 mag were also present within the above mentioned observing run. This indicates that both components show strong chromospheric activity presently in the inner Langrange point region. On account of these outstanding lightcurve variations the system should also be a variable X−ray source.

From 7 observed Min II, given in Table I, we derived the following light elements:

$$\text{Min II} = JD_{hel}\ 2448840.4548 + 0^{d}.374460 \times E \qquad (1).$$

An objective prism plate of 75 min exposure, taken by V. Mette with our 35/50/137.5cm Schmidt camera does not show clear spectral lines on account of the rapid rotational line broadening. Comparing this smeared 'continuous' spectrum with those of the neighbouring stars we conclude that the spectral type is conform with the B−V=0.70±0.065 colour given by Hutton, indicating a G5 type.

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H_α PROFILE VARIATIONS IN THE Be/SHELL STAR ζ Tau DURING 1990-1992

ζ Tau is one of the well-known V/R variable shell stars and a single-lined spectroscopic binary with an orbital period of 133 days. Losh (1932) first observed irregular radial velocity variations superimposed on the orbital variation. Delplace (1970a) found long-term pseudo-periodic variations in the radial velocities of the shell absorption lines. From radial velocity measurements published before 1976 and summarized by Harmanec (1984) it can be seen that the long-term pseudo-periodic variations started in the late 1950's after a long quiescent phase. Hubert-Delplace et al. (1983) showed the radial velocity variations of visible shell lines during 1975–1980 to be a continuation of the pseudo-periodic variations. Recently Mon et al. (1992) put forward that the pseudo-periodic variation (that started in $\sim$ 1976) has terminated around 1982, and the star seems to have entered a new quiet phase.

Here we present our recent results. All observations were made with the All-Fiber-coupler grating spectograph of the 2.16 m telescope at the Beijing Observatory (Wang 1991) during 1990 Dec.–1992 Feb. The detector was a CCD with 576 $\times$ 512 pixels. The reciprocal linear dispersion of the spectra was 50Å/mm at H_α. One pixel corresponds to 1.15Å. The integration times of every spectrum were chosen to be approximately 80–90 % of what is needed to saturate the CCD in the central part of the H_α emission. The S/N ratio near the continuum level was >150. The spectrum of a neon lamp was recorded for wavelength calibration, and flat-field of the detector was determined by exposing to the light of a mercury lamp several times a night under the same conditions. The data were reduced using the Starlink Image Processing Software on the Vax 11/780 computer of the Beijing Observatory. The main steps of the reduction consisted of the correction for read-out-noise, correction for flat-field, wavelength calibration, and normalization to continuum intensity.

Our results are summarized in Table 1. The first three columns are the date of the observation, the number of H_α profiles, and the duration of the observation (Δt) on each night. The 4th and 5th columns denote the equivalent width (W_α), and the full-width-at-half-maximum (FWHM) intensity of the average H_α profile for each night in angstroms. The 6th to 8th columns give the violet emission, central depression, and red emission intensities, respectively, relative to the continuum (VE, CD, and RE). The last column is the violet-to-red peak intensity ratio (V/R). Fig.1 illustrates the H_α profiles of the star observed at different times. Each panel in the Figure consists of all profiles obtained on a given night. These results show that the H_α profiles underwent marked variations in shape, and its W_α, FWHM, VE, CD, RE, as well as V/R were also changing with time

Table 1. Hα Observations of ζ Tau

Date	No. of profiles	Δt (min.)	Wα (Å)	FWHM (Å)	VE	CD	RE	V/R
Dec. 25, 1990	5	45	19.7	10.69		2.40		
Oct. 09, 1990	20	82	20.1	10.69	2.96	1.60	2.17	1.36
Dec. 16, 1991	15	75	22.5	10.69	2.85	2.02	2.30	1.24
Dec. 27, 1991	4	26	22.3	10.69	2.78	2.02	2.24	1.24
Feb. 26, 1992	4	32	24.4	11.08	2.78	2.02	2.66	1.05
Feb. 27, 1992	6	38	23.8	11.04	2.78	2.03	2.65	1.05

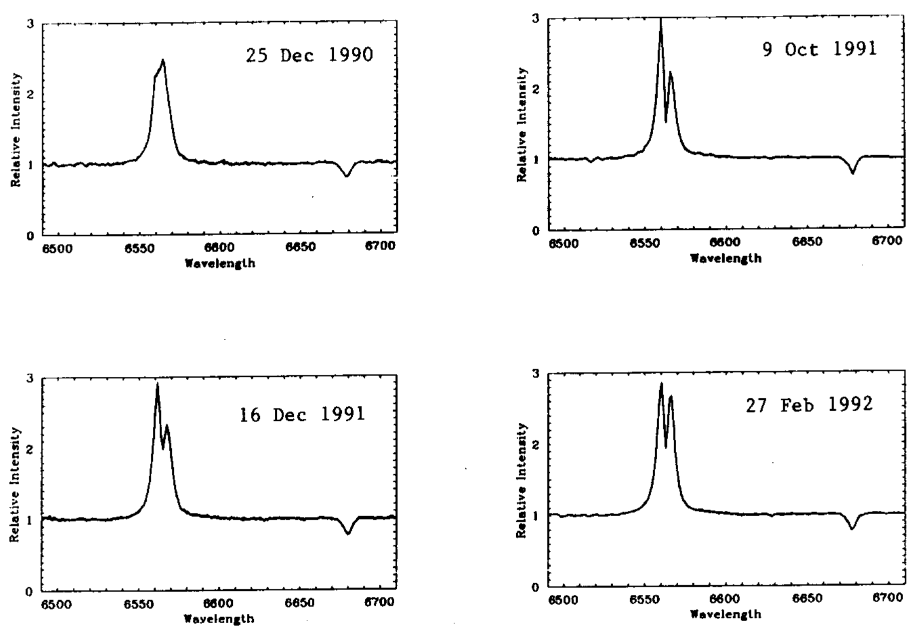

Fig. 1 The Hα profiles of ζ Tau in the different observed periods

in the period of our observations. The 1990 December 25 profiles appeared as a single emission with an asymmetric top (no visible central depression) but the profiles from 1991 Oct. to 1992 Feb. displayed prominent double emission peaks with V > R. These variations indicate that the circumstellar envelope which gave rise to the H_α emission has recently been in some unstable state. In order to understand further the variability, we try to compare the profile variations of the earlier active phase of the star with more recent changes. It is interesting that we found the H_α profiles in the earlier pseudo-periodic-variation years as published by other authors also exhibited similar variability. For instance, while around 1976, when the radial velocities of the shell absorption lines were near zero on the ascending branch during the 1976-1982 activity cycle, H_α appeared as a single emission (Slettebak and Reynolds, 1978, Fontaine et al. 1982), it displayed, in contrast, double emission with $V > R$ in 1979, near the radial velocity maximum (Gao et al. 1986). In addition, the H_α profiles at different phases of the pseudo-periodic variability presented by Delplace (1970b) during the 1960–1967 activity cycle also showed similar behavior. Therefore, we may speculate that the stellar envelope entered a new active phase near 1990 Dec. or even earlier, that the radial velocity of the shell absorption lines was near zero in a transition from negative to positive in 1990 Dec. and would progressively increase to reach a positive maximum sometime later, although we do not have the nessesary radial velocity information of the shell absorption lines. Interestingly, our speculation is supported by a report on the radial velocity of the H_γ and metallic shell lines by Ballereau et al. (1992). We think it is most desirable to continue monitoring the star and studying the possible cause(s) of its remarkable variations.

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ON THE GENUINE V2045 OPHIUCHI

A star at the 1950 position of $16^h48^m37^s.0$ $-6°9'39"$was announced by Nassau et al. (1964) as a new Mira-type variable, on account of its objective-prism spectrum which indicated an M-type giant showing Hδ in emission stronger than Hγ. The only brightness value known up to now has been Nassau's mpg=$12^m.1$ from a Cleveland plate, and despite of this meagre data the object gained entry to the GCVS as V2045 Oph.

Because of our very fragmentary knowledge of the star we tried to investigate it on photovisual plates of the Sonneberg Sky Patrol (taken between 1963 and 1991 mainly by H. Huth and B. Fuhrmann), since it must be avoided that Nassau's observation one day will be taken for a single burst of some strange eruptive object. This danger proved to be even larger than we originally thought because the object indicated on the chart of Nassau et al. (l. c.) is neither red nor conspicuously variable on our plates.

However, it turned out that approximately $3'.7$ to the south of indicated star a typical Mira star exists. It is depicted just inside of Nassau's chart (22 mm apart from the eastern and 2 mm from the southern margin) and can also easily be identified by its red colour on the POSS O and E sheets, where it is obviously near minimum phase. We have hints for 7 maxima on our plates. Their dates yield a period of roughly 304^d and a maximum brightness of $12^m.0$ pv (roughly equal to the brightness of star A of our chart), the minimum being below the threshold fainter than about $13^m.5$ pv. On our blue sensitive plates taken simultaneously with the photovisual ones the star appears in maximum slightly brighter than $14^m.0$.

Doubtless we have observed the genuine M5e Mira-type star, and the chart of Nassau et al. (l. c.) is wrong. Also the position given by these authors fits our object. It is very probable, therefore, that at JD 243 7111 they met the star during an extraordinarily bright maximum. On our chart the variable is indicated by its designation and the wrong star by two strokes.

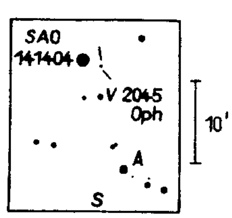

Figure 1

We thank Mr. D. Böhme for directing the attention to this star. Part of the work has been supported by funds of the Bundesministerium für Forschung und Technologie under contract no. 05–5S0414.

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PHOTOELECTRIC LIGHT CURVES OF TY PUPPIS

The variability of TY Pup was discovered by Hertzsprung (1928). Campbell (1928) made the first photometric measurements, and proved that TY Pup is a W UMa–type eclipsing binary, with a period of about 0.58 days. Spectrographic observations were made by Struve (1950), but only one component spectrum, classified as around A9n, was detected. In 1957, Huruhata et al. carried out photoelectric observations in three colours. Later, Van Houten (1971) gave out a correct period of about 0.82 days.

The present BV–band observations of TY Pup were made one nine nights during January to February, 1985 at Yunnan Observatory with a 35cm reflecting telescope and single–channel photoelectric photometer. The comparison and check star were BD$-20°2015$ and BD$-21°1986$, respectively. 612 observations were obtained at each effective wavelength.

We determined three minima from the observations. They are given in Table 1. These three minima along with another minimum time (Van Houten, 1971) were introduced into a least squares solution to obtain the following improved ephemeris. This ephemeris was used in calculating the O–C values in Table 1.

$$\text{JD Hel Min. I} = \underset{\pm 10}{2446087.1142} + \underset{\pm 14}{0^{d}.81929882} \times E$$

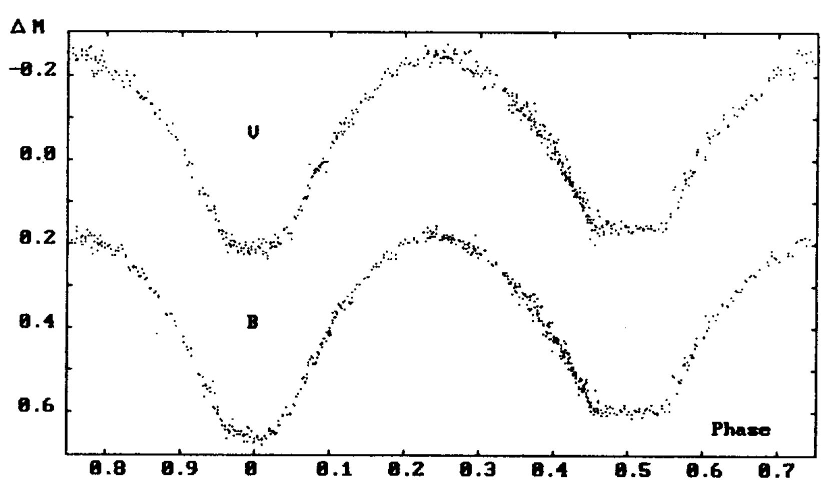

Fig.1 Light curves of TY Pup

Table 1

JD Hel	Minimum	Cycles	O–C
2446000+			
86.2934	I	−1.0	−0.0015
87.1161	I	0.0	0.0019
107.1867	II	24.5	−0.0003

The B, V light curves are shown in Figure 1. The new light curves are different from Huruhata et al.'s light curves. The analysis of the observations will be published in a Chinese or a foreign astronomy journal.

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DO ALL THREE VARY: o UMa, 23 UMa AND HR 3245?

Jackisch (1963) had reported, on the basis of 16 observations between 1954 and 1957, that o UMa (HR 3323, NSV 4093) was variable by 0.08V in a period of 358 days. He also indicated the possibility of a secondary period of 0.05 day with an amplitude of 0.02V. The recent NSV catalogue (Kholopov 1982) gives a range from 3.30 to 3.36V. However, these values come from the USNO catalogue of photoelectric magnitudes (Blanco 1968) and do not necessarily indicate the amplitude of the suspected variable, only the range of discordances among six observers using different equipment. In not one of the six determinations was any suspicion of variability mentioned. Jackisch fortunately indicated which two stars he had used for comparison, HR 3245 and HR 3757 (23 UMa, NSV 4506). Both have subsequently been reported as variable. Henriksson (1977) found HR 3245 to be a possible eclipsing variable, 5.74V, amp. 0.062V. HR 3757 had been announced by Lau (1914) as varying from 3.3 to 3.8v in a short period. But a visual variation of only 0.5 mag. is within the probable errors of naked-eye determination. The recent NSV gives 3.65−3.68V, but this again represents the discordance among five independent observers.

Clearly, all three of these stars (Table I) should be observed photoelectrically to ascertain which actually do vary, and to determine types and periods for those that do.

Table I

HR	Name	NSV	(1950)	V	amp?	Per. d
3245	–	–	$8^h14^m57^s$+62°39′.8	5.7	0.06	
3323	o UMa	4093	8 26 06 +60 53.3	3.3	0.08?	358?
3757	23 UMa	4506	9 27 37 +63 16.9	3.7	0.03	short

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COMPLETE CCD V, R, I LIGHT CURVES OF BM URSAE MAJORIS

BM Ursae Majoris (S 7742) was discovered by Hoffmeister (1963) and was identified as a short period variable. Busch (1966) classified the variable as an RR Lyrae type-c star, determined five timings of minimum light, and calculated preliminary light elements. Shugarov (1975) correctly identified BM UMa as an EW-type eclipsing variable, and gave an improved ephemeris. Hoffmann (1981) published photoelectric B, V light curves from one night's observations along with two times of minimum light and an improved ephemeris based on his and previous timings. Despite the fact that his curves showed rather high scatter and indicated that BM UMa was most likely a contact binary, he applied the Russell-Merrill technique and came to the conclusion that the eclipses were complete. Based on the atlas of Anderson and Shu (1979), he concluded that the fill-out was on the order 50% which would be quite an unusual value for a system of this type. Hoffmann's observations are available on microfilm (1984). Eighteen visual timings of minimum light have been published in various issues of the BBSAG (#57–#95).

As a part of our recent campaign to obtain complete, definitive, multiband light curves of compact non degenerate systems near the low period limit ($0\overset{d}{.}22$), we have obtained V, R, I CCD light curves of BM UMa. Our present observations of this 14^m variable were made from 22–24 March 1991, inclusive at Lowell Observatory, Flagstaff, Arizona. An RCA CCD camera system was utilized, in conjunction with the 1.07m John S. Hall reflector telescope with the F/8 secondary. The 320 x 512 pixel CCD chip was cooled with liquid Nitrogen throughout the observing interval to −130°C. Approximate coordinates of the check, comparison and the variable star are given in Table 1. About 130 images in V, 115 images in R and 75 in I were obtained with integration times ranging from 90 to 180 seconds.

Table 1

Star	R. A. (2000)	Dec. (2000)
BM UMa	$11^h11^m18\overset{s}{.}9$	46°25'41"
Comparison	$11^h11^m20\overset{s}{.}1$	46°26'08"
Check	$11^h11^m19\overset{s}{.}8$	46°23'39"

Four mean epoch of minimum light were determined from the observations made during one secondary and three primary eclipses. The bisection of chords technique was utilized to determine all epochs in V, R and I. These are given in Table 2 accompanied by their standard deviations in parentheses. The two earlier photoelectric epochs by Hoffmann (1981) also appear in Table 2. The six precision epochs were introduced into a least

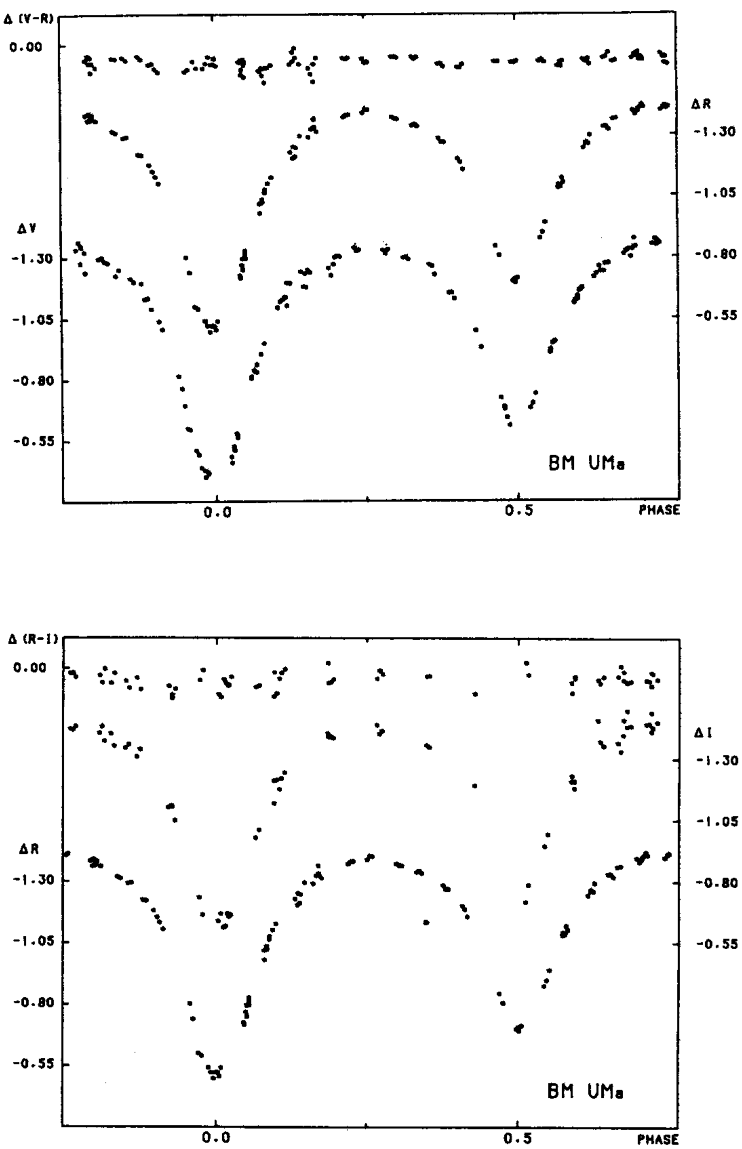

Fig. 1–CCD Light curves of BM UMa as defined by the individual observations.

squares solution to obtain a linear ephemeris. A quadratic ephemeris was also determined from *all available epochs* of minimum light with visual timings given a weight of 0.1. The epochs determined from CCD and photometric observations were given a weight of 1.0 with the exception of our last timing which was given a lower weight of 0.5. The improved ephemerides are:

$$\text{JD Hel Min. I} = \underset{\pm 8}{2444292.3496} + \underset{\pm 7}{0^{\mathrm{d}}.27122007} \times \mathrm{E} \text{ and,}$$

$$\text{JD Hel Min. I} = \underset{\pm 14}{2444292.3520} + \underset{\pm 8}{0.27121927} \times \mathrm{E} - \underset{\pm 11}{1^{\mathrm{d}}.03 \times 10^{-10}} \times \mathrm{E}^2$$

Table 2

JD HEL. 2400000+	Minimum	Cycles	$(O-C)_1$	$(O-C)_2$
44292.3496	I	0.0	−0.0000	−0.0020
44292.4853	II	0.5	0.0000	−0.0023
48338.9529(4)	I	14920.0	−0.0002	−0.0020
48339.7656(4)	I	14923.0	−0.0011	−0.0029
48339.9022(6)	II	14923.5	−0.0002	−0.0019
48340.8547	I	14927.0	0.0031	0.0013

The linear ephemeris was used to calculate the $(O-C)_1$ residuals in Table 2 and phases of the present observations. The quadratic ephmeris was used to calculate the $(O-C)_2$ residuals. The quadratic term in the second ephemeris is rather large and is statistically significant. It is slightly larger than the value determined for BX Peg (Samec 1990, Samec and Hube 1991). BX Peg is coalescing rapidly into a single star due to magnetic braking. So, BM UMa may be in a similar phase.

The V, R, and I light curves of BM UMa as defined by their individual observations are shown in Figure 1 as differential magnitude (variable−comparison) versus phase. The analysis of the observations in underway.

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NEW RESULTS ON THE HIGH AMPLITUDE DELTA SCUTI STAR BE Lyn

The variability of BE Lyn was discovered in April 1985 by Oja (1986) during routine UBV observations of astrometric standard stars. Oja (1987) and Rodriguez et al. (1990a) carried out two extensive sets of photometric observations, found the object to be a high amplitude Delta Scuti star, and published the following elements, respectively:

$$\text{JD hel. max.} = 2446506.0074 + 0.0958697 \times E \qquad \text{(I)}$$
$$\text{JD hel. max.} = 2446951.41733 + 0.095869448 \times E \qquad \text{(II)}$$

The monoperiodicity of BE Lyn is also confirmed by Poretti et al. (1990). Physical parameters of the pulsating variable are published by Rodriguez et al. (1990a), Rodriguez et al. (1990b) and Garrido et al. (1990).

As a result of a new set of photoelectric observations, obtained in 1991 at the 0.34m Cassegrain telescope of the Nürnberg Observatory, we present seven new times of maxima. Using a 1P21 phototube, all observations were made in V colour. The light curve of BE Lyn (April 1991) is shown in Figure 1. There seems to be an increased scatter at phase 0.1−0.3, which may be due to some bumps. The observational data is accessible on request.

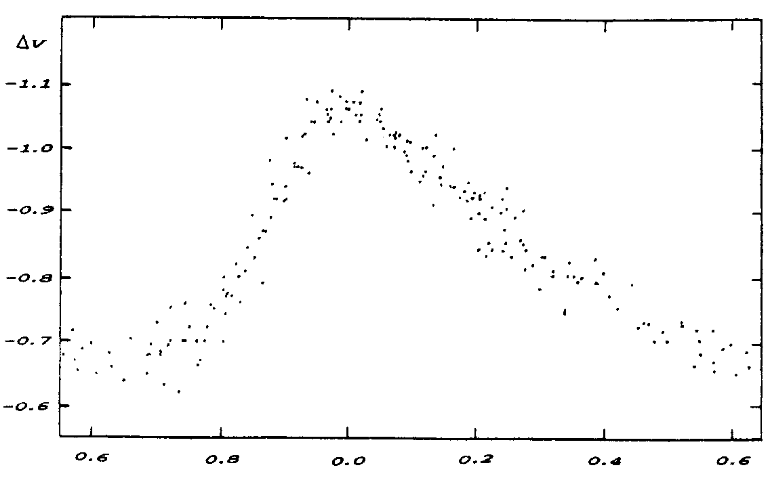

Fig.1. Light curve of BE Lyn (P=0.095869483)

Table 1
Photoelectric maxima of BE Lyn

JD hel. max.	Epoch	O-C(I)	O-C(II)	Obs.	Reference
2446498.3379	-19287	+.0001	-.0003		Oja (1987)
6507.3501	-19193	+.0005	+.0001		Oja (1987)
6507.4459	-19192	+.0005	+.0001		Oja (1987)
6508.4049	-19182	+.0008	+.0004		Oja (1987)
6509.4587	-19171	±.0000	-.0004		Oja (1987)
6510.4175	-19161	+.0001	-.0003		Oja (1987)
6524.4152	-19015	+.0008	+.0005		Oja (1987)
6950.4595	-14571	+.0002	+.0008		Rodriguez et al. (1990a)
6951.4174	-14561	-.0006	±.0000		Rodriguez et al. (1990a)
7115.6420	-12848	-.0008	+.0002		Rodriguez et al. (1990a)
7118.6131	-12817	-.0017	-.0006		Rodriguez et al. (1990a)
7118.7102	-12816	-.0005	+.0006		Rodriguez et al. (1990a)
7121.6813	-12785	-.0013	-.0003		Rodriguez et al. (1990a)
7219.5637	-11764	-.0019	-.0006		Rodriguez et al. (1990a)
7551.4645	-8302	-.0020	±.0000		Rodriguez et al. (1990a)
7551.5599	-8301	-.0024	-.0004		Rodriguez et al. (1990a)
7551.6560	-8300	-.0022	-.0002		Rodriguez et al. (1990a)
7553.5729	-8280	-.0027	-.0007		Rodriguez et al. (1990a)
7553.6692	-8279	-.0023	-.0003		Rodriguez et al. (1990a)
8347.3728	0	-.0039	-.0001	Wu	this paper
8347.4679	1	-.0047	-.0009	Wu	this paper
8357.3444	104	-.0028	+.0011	Wk/Wu	this paper
8358.3988	115	-.0029	+.0009	Wk/Wu	this paper
8359.3557	125	-.0047	-.0009	Gz/Wu	this paper
8367.5060	210	-.0034	+.0005	Wk	this paper
8624.3400	2889	-.0043	+.0002	Wk/Wu	this paper

Abbreviations of the observer's names:

Gz = M. Garzarolli   Wk = M. Wieck   Wu = E. Wunder

On the base of all known times of maxima, listed in Table 1, we calculated the improved elements of BE Lyn by the method of least squares:

$$\text{JD hel. max.} = 2448347.37290 + 0.095869483 \times E \qquad \text{(III)}$$
$$\pm 18 \qquad\qquad \pm 14$$

The difference to the elements of Oja (1987) and Rodriguez et al. (1990a) exceeds significantly the error of the new elements. We therefore propose to use the improved formula for ephemeris.

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A PHOTOMETRIC SURVEY OF SMALL-AMPLITUDE RED VARIABLES

Introduction. Small-amplitude red variables (SARVs) are M giants which are pulsating with small amplitudes and with periods of 20 to 200 days (but typically 50 to 100 days). They are red giant or asymptotic giant branch stars. A detailed study of a typical SARV (EU Del) has been reported by Percy et al. (1989). As a long-term project, one of us (JRP) is accumulating and analyzing observations of SARVs using a variety of techniques and sources, in order to clarify the status of the hundreds of suspected or poorly documented SARVs in the *Yale Catalogue of Bright Stars*, as well as to understand the systematics, evolutionary status, pulsation properties, and other processes in these stars. In 1990 and 1991, observations of SARVs were made using the 0.4m "teaching telescope" on the main campus of the University of Toronto. The 1990 results were reported by Percy and Fleming (1992) and the 1991 results are reported here. The variables which have been discovered or confirmed in 1990 and 1991 will be followed up by the American Association of Variable Star Observers (AAVSO) photoelectric photometry program, or with the Automatic Photometric Telescope (APT) Service in Arizona.

Observations and Results. The observational procedures are the same as described by Percy and Fleming (1992). Tables of individual observations will be deposited in the IAU Commission 27 Archives of Unpublished Photoelectric Photometry (Breger 1988). The results are summarized in Table 1. The "remarks" column refers mainly to information from the *General Catalogue of Variable Stars* (GCVS: Kholopov 1985) and the *New Catalogue of Suspected Variables* (NSV: Kholopov 1982). Because our data are not as extensive or precise as those obtained by Percy and Fleming (1992), we have not shown individual light curves. Copies of these can be obtained from JRP, or from the archival data.

HR 5590. The amplitude is <0.10 and the period, if any, is about 30 days. Unfortunately, the comparison stars show large scatter.

HR 5594. This star appears constant, but one of the comparison stars may be slightly variable.

HR 5654 (FL Ser). There is scatter in the comparison stars, so we cannot confirm the GCVS classification (Lc) or amplitude (0.23).

HR 5879 (NSV 7269). The range appears less than 0.05. The check star 5 Her (G8III) appears to be variable.

	HR	HD	V	SpT	Result	Remarks
Pgm	5590	132833	5.52	M0III	var?	VAR?
Co	5573	132132	5.53	K1III	var?	
Ch	5536	130970	6.18	K3III	var?	
Pgm	5594	132933	5.71	M0.5IIb	const?	VAR?
Co	5601	133165	4.40	K0.5III	const?	
Ch	5631	134047	6.16	K0III	const?	
Pgm	5654	134943	5.89	M4III	var?	FL Ser, Lb, $\Delta V=0.23$
Co	5692	136138	5.70	G8III	var?	
Ch	5740	137510	6.27	G0IV-V	var?	
Pgm	5879	140477	4.09	M4III	const?	VAR? 35 κ Ser
Co	5924	142574	5.44	M0III	const?	
Ch	5966	143666	5.12	G8III	var	5 Her
Pgm	5932	142780	5.37	M3III	const?	VAR? 2 Her
Co	5950	143209	6.31	K0	const?	
Ch	5957	143435	5.62	gK5	const?	
Pgm	6010	145002	5.73	M3.5III	var?	FS Ser, $\Delta V=0.04$
Co	6014	145148	5.97	K0IV	const?	
Ch	6011	145085	5.91	gK5	const?	
Pgm	6056	146051	2.74	M0.5III	const	VAR? δ Oph
Co	6075	146791	3.24	G9.5III	const	2 ϵ Oph
Ch	6016	145206	5.37	K4III	var?	
Pgm	6107	147749	5.20	M2III	const?	VAR? 20 ν^1 CrB
Co	6108	147767	5.39	K5III	const?	21 ν^1 CrB
Ch	6043	145802	6.29	K2III	const?	
Pgm	6128	148349	5.23	M2.5III	var?	V2105 Oph, $\Delta V=0.06$
Co	-	145894	6.84	K0	var?	
Ch	-	144892	6.70	F6V+F8V	var?	
Pgm	6200	150450	4.90	M2.5III	const	VAR? 42 Her
Co	6183	150030	5.79	G8II	const	
Ch	-	149105	7.00	G0V	var?	
Pgm	6346	154356	6.69	M4III	var	VAR? 61 Her
Co	6336	154126	6.36	K0	const	
Ch	6328	153897	6.55	F5V	const	
Pgm	6495	157967	5.98	M4III	var	V640 Her, Lb, $\Delta V=0.17$
Co	6542	159353	5.69	gK0	const?	
Ch	6541	159332	5.64	F6V	const?	

	HR	HD	V	SpT	Result	Remarks
Pgm	6765	165625	5.06	M3III	const?	VAR? 98 Her
Co	6820	167193	6.12	K4III	const	
Ch	-	166842	6.67	K1III	const	
Pgm	6834	167654	6.01	M4III	const	VAR? $\Delta V=0.10$
Co	6866	168656	4.86	G8III	const	74 Oph
Ch	6857	168387	5.39	K2III	const?	
Pgm	7405	183439	4.44	M0III	const?	VAR? 6 α Vul
Co	7406	183491	5.81	K0III	const?	8 Vul
Ch	7421	184010	5.87	K0III-IV	const?	
Pgm	7414	183630	5.03	M1III	const	36 Aql
Co	7404	183387	6.25	K2	const	
Ch	7438	184663	6.38	F6IV	const?	
Pgm	7442	184786	5.96	M4.5III	var	VAR? $\Delta V=0.10$
Co	7427	184293	5.53	gK1	const?	
Ch	7451	184960	5.73	F7V	const?	
Pgm	7635	189319	3.47	M0III	const	VAR? 12 γ Sge
Co	7662	190211	5.96	K3II-III	const	
Ch	7679	190608	5.10	K2III	const?	16 η Sge

HR 5932 (NSV 7335). The variability, if any, appears small; there is larger-than-average scatter in all three stars.

HR 6010 (FS Ser). This star appears to be slightly variable. The GCVS amplitude is very small (0.04 in V), and we cannot confirm or refute it.

HR 6056 (NSV 7556). This star appears constant, but the NSV amplitude is small (0.03 in V) and not inconsistent with our result. The check star HR 6016 (K4III) may be slightly variable.

HR 6107 (NSV 7676). The variability, if any, is small. The NSV amplitude is 0.08 in V.

HR 6128 (V2105 Oph). The amplitude is at least 0.2 in V, and the time scale appears to be 30 days or more. The range, according to the GCVS, is 5.0 to 5.38 in V, which is consistent with our result.

HR 6200 (NSV 7896). Our five observations do not indicate any variability, but they are insufficient to rule out the small range (0.05 in V) given in the NSV.

HR 6346 (NSV 8159). This star is definitely variable. Our results are consistent with the NSV range of 0.2 in V. The time scale is not well-defined, but appears to be 30 days or more.

HR 6495 (V640 Her). The range is consistent with that given in the GCVS (0.17 in V). The time scale (based on our limited data) is about 100 days.

HR 6765 (NSV 10208). Our six observations do not indicate any variability. The NSV range is 0.13 in V.

HR 6834 (NSV 10466). Our five observations do not indicate any variability. The NSV range is 0.14 in V.

HR 7405 (NSV 12069). Our six observations are consistent with the NSV amplitude (0.07 in V), and a time scale of 50 days, but there is larger-than-average scatter in the comparison stars.

HR 7414. This star appears to be constant.

HR 7635 (NSV 12638). This star appears to be constant, though the time distribution of our six observations may have been such that the NSV amplitude of 0.09 in V was missed.

Discussions and Conclusions. The data which we obtained in 1991 were not as extensive and precise as the data obtained in 1990 (Percy and Fleming 1992), so our conclusions about the variability of individual stars are not as secure. The proportions of non-variable, possibly variable, and definite variable stars were about the same. The general correlations between spectral type, amplitude and time scale of variability (Percy and Fleming 1992, figure 3) remain the same.

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OW Gem: THE 1991 PRIMARY MINIMUM

The variability of SAO 095781, which was previously listed as the possible variable NSV 03005, was confirmed by Kaiser et al. (1988a). This star was found to be a long-period eclipsing binary with period $1258^{d}.56$ by Kaiser (1988b). Its new name is OW Gem. Kaiser predicted the next primary miminum to occur on September 2, 1991.

The CCD photometry of OW Gem during the primary minimum presented here is part of an observing program, of which the results will be published soon (Hanžl et al. 1992).

From August 30 to September 13, 1991, CCD observations of the long-period eclipsing binary OW Gem were performed at the Ondřejov Observatory during 7 nights. A small SBIG ST-4 camera with 7-cm lens (focal length of 10.5 cm) was used. Having only an 8-bit AD convertor, this camera was not designed as a photometric device, but when certain conditions are fulfilled, it can be used as a multichannel photometer that yields an accuracy of about 0.03 mag. These conditions are the following:

- the peak signal of the measured object must be kept in the upper half of the dynamical range of the CCD-camera (that is, 0 to 255);
- when the image of the measured object extends over several pixels, the error due to a finite number of levels of analogue-digital (8-bit) conversion is suppressed.

These conditions were fulfilled only during the last three nights on account of the strong interference of the Moon during the first four nights.

During each observing night, one to three images of the star field around OW Gem — including the variable star and comparison stars — were obtained. The comparison stars were SAO 095777, SAO 095810, and the third star at R.A.(1950)= $6^{h}29^{m}02^{s}$, Decl.(1950)= $+17°08'05''$ (Kaiser et al. 1988a). Observing conditions were not ideal; there was strong interference of the Moon before September 5 and measurements were performed at an air mass of about 2.2 at the beginning of dawn. Exposures varied from 15 to 60 seconds, with median value 30 seconds. No filter was used; the maximum of the spectral sensitivity of the camera has a flat maximum around 730 nm with halfwidth of 350 nm (530–880 nm).

Dark subtraction and flat fielding of images were performed and also sky subtraction was made. Signals of the variable star and all the comparison stars were measured by integrating counts over a 3x3 pixel area centered at the position of the measured object (such a 3x3 pixel box contains more than 96% of all light of the measured star). In what follows, we briefly describe the reduction procedure.

The comparison stars were assumed to be non-variable (checked by residuals after reduction). Co-adding signals from all comparison stars in a particular image we obtained the intensity of a fictitious star less affected by a noise. Differential magnitudes of all comparison stars as well as the variable star with respect to the fictitious star were then obtained. Errors of differential magnitudes of comparison stars were derived from deviations from the mean values on individual images (errors of summed signals were also accounted for). The accuracy of a differential magnitude of OW Gem at every particular image was estimated from errors of comparison stars by comparing the signal of the variable with signals of comparison stars on the image. Finally, a constant value was added to all differential magnitudes to reduce the mean differential magnitude of SAO 095810 to zero.

The mean differential instrumental (ST-4) magnitudes of the comparison stars were SAO 095810: 0.000±0.009; SAO 095777: 1.268±0.014; the third star: 2.086±0.032.

The standard errors of differential instrumental magnitudes of OW Gem were found to be between 0.014 and 0.058 (average 0.031 mag), except for measurements on September 2 and 3, when the use of the ST-4 camera as multichannel photometer was not possible. The magnitudes obtained are given in Table 1.

Table 1: Differential instrumental (ST-4) magnitudes of OW Gem.

UT 1992	$JD - 2448000$	ΔMag_{instr}	Exposure (seconds)
Aug. 30.0936	498.5936	0.698 ±0.056	30
Sept. 2.0820	501.5820	1.38 ±0.19	30
3.0913	502.5913	1.343 ±0.083	30
3.0921	502.5921	1.36 ±0.16	15
4.0939	503.5939	1.140 ±0.026	30
4.0949	503.5949	1.092 ±0.058	15
4.0957	503.5957	1.215 ±0.029	60
5.0892	504.5892	0.917 ±0.018	30
5.0906	504.5906	0.918 ±0.027	60
10.0754	509.5754	0.252 ±0.014	30
10.0764	509.5764	0.316 ±0.024	15
10.0767	509.5767	0.258 ±0.016	60
13.1032	512.6032	0.201 ±0.048	30
Sept.13.1040	512.6040	0.209 ±0.026	30

Our observations confirm the correctness of Kaiser's prediction of the 1991 primary minimum of OW Gem. Combining these measurements with results obtained by D. Hanžl, D. Chochol, and J. Papoušek, we derived an improved ephemeris for OW Gem. That analysis will be published by Hanžl et al. (1992).

The author is very grateful to the Santa Barbara Instrument Group, Santa Barbara, California, for lending the CCD-camera used in these observations. I also thank Dr. C. Sterken for carefully refereeing and commenting this paper.

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FLARE STARS IN THE PRAESEPE CLUSTER REGION

Examination of photographic material of the Praesepe cluster region from Tonantzintla Schmidt plates, covering the interval 1976-80 allowed us to find two new flare stars and 9 flare-ups of known stars. The total observational time is about 102 hours.

In Table 1 in first column we continue the Tonantzintla numbering of the Praesepe flare stars, then the equatorial coordinates, ultraviolet magnitude at minimum, the amplitude of flare event, the date of flare are given respectively.

Table 1
New flare stars in the Praesepe region

Ton	α_{1950}	δ_{1950}	U	ΔU	Date of flare
25	$8^h39^m.3$	20°51′	15.6	0.6	14 March 1978
26	44.1	20 46	>17	>3.5	13 March 1978

In Table 2 data on repeated flare-ups of known flare stars which are non-members or probable non-members are given.

In the first column the Praesepe Flare Star Catalogue number is given (Tsvetkova et al. 1991).

Table 2
Repeated flares in the Praesepe region

PFSC	TON	U mag	ΔU mag	Date of flare
3*	12	13.9	3.5	16 March 1977
3	12	13.9	3.0	22 March 1977
3	12	13.9	2.0	13 March 1978
3**	12	13.9	2.0	16 April 1980
4	13	15.8	0.5	10 March 1978
4	13	15.8	1.9	01 April 1978
11	15	16.5	2.0	19 March 1980
53	23	17.0	0.8	04 March 1978

* Three images ($15^m \times 3$) before the fast flare-up were about 0.5 mag brighter than normal minimum. Star can be variable at minimum light.

** This flare-up was slow, rise time was longer than 30 minutes and total time of flare is 2^h15^m.

During 102 hours of observations only two new flare stars were found. From among 57 known flare stars of the Praesepe catalogue only 48 can be considered as members of the cluster. The total expected number of flare stars in the Praesepe cluster according to Ambartsumian's method (Ambartsumian et al., 1970) is about 160. The mean period of flare-ups of cluster flare stars is about 2000 hours. It confirms once more, that the Praesepe cluster is poor of flare stars and with the age of the cluster, the mean frequency of flare-ups increases.

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A Probable RV Tauri Star Near HR Del

The Indiana University 16-inch automated CCD photometric telescope (Honeycutt et al., 1989; 1990; 1992) acquires about 100 exposures each clear night, mostly on a program involving nightly monitoring of nova-like and SU UMa CV's. The photometric reduction technique used for ensemble photometry on inhomogeneous data sets (Honeycutt, 1992) provides, as a by-product, the light curve of all stars in the field. Consequently, the program is discovering a number of new variable stars, one of which is described here.

A computer-generated finding chart for the new variable is shown in Figure 1. A photographic finding chart of this same field can be found in Duerbeck (1987). The coordinates of the variable are 20:42:12, +19:09:22 (2000.0), with an accuracy of about 5 arc-seconds.

The light curve in Figure 2 shows variations of about one magnitude with a complicated behavior. As described in Honeycutt (1992), the error bars correctly represent the uncertainty of the differential photometry, but the zeropoint of the magnitude scale has an uncertainty of about ± 0.2 mag. The portion of the light curve beyond JD = 2448700 is quite sinusoidal with a best fit

$$V = V_o + A*\sin(2\pi*(JD-JD_o)/P)$$

where V_o = 14.7 (± 0.02) mag (± 0.2 mag including zeropoint error),
A = 0.5 (± 0.02) mag,
JD_o = 2448778 (± 1) days,
P = 97 (± 1) days.

This sine wave also fits some of the data before JD = 2448700, but data near JD = 2448450 are discrepant.

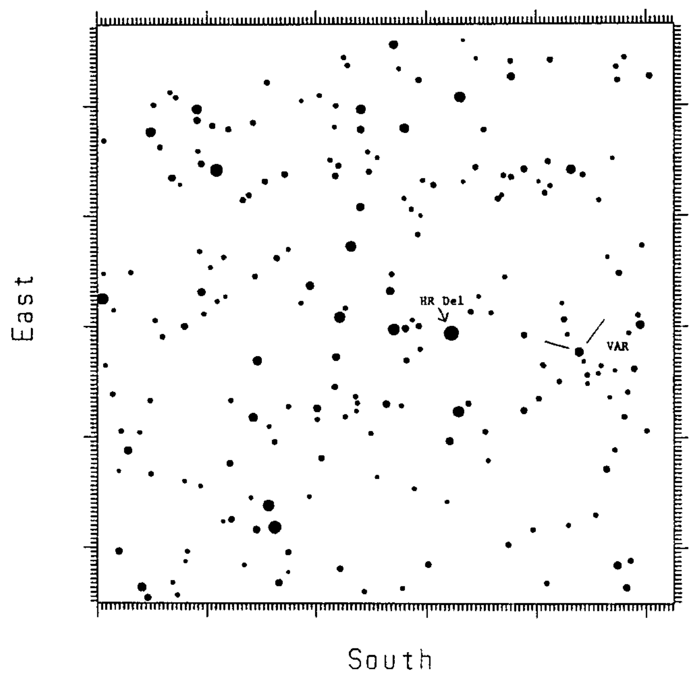

Figure 1: Finding chart with HR Del and the new variable marked. The field is 7.2 arc-minutes on a side.

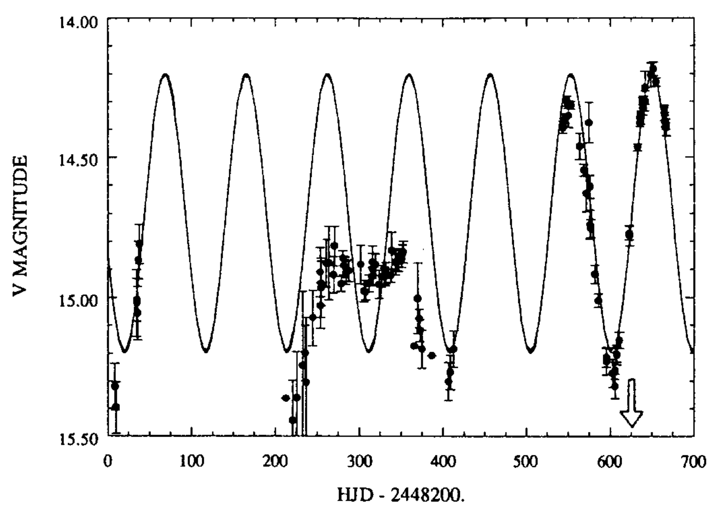

Figure 2: V-band CCD photometry of the new variable in the years 1990-1992 with a sine curve fit. The arrow marks the time of the spectrum in Figure 3.

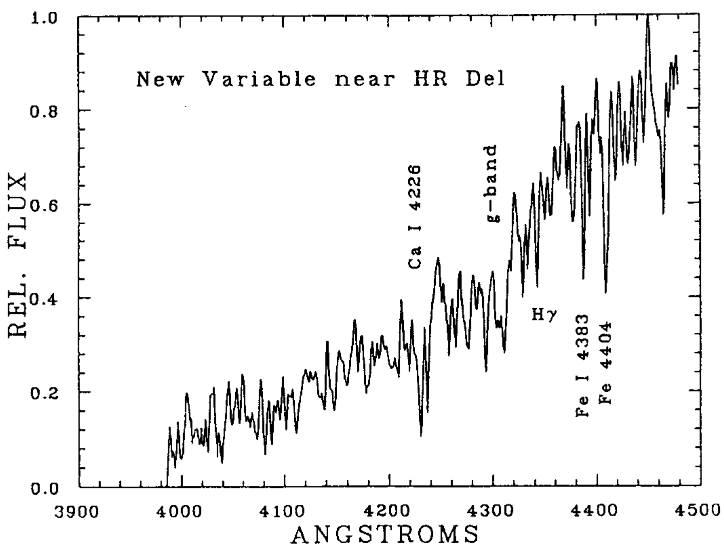

Figure 3: A blue spectrum of the new variable.

Figure 3 is a blue spectrum of the new variable obtained on August 22(UT), 1992 with the Ohio State CCD spectrograph on the Perkins 1.8-meter telescope of the Ohio Wesleyan and Ohio State Universities at the Lowell Observatory. The resolution is 2.5 Angstroms. The spectrum was obtained through clouds and the S/N is consequently poor. Nevertheless, enough features are visible to conclusively identify the spectral type as K. The arrow in Figure 2 marks the date when the spectrum was obtained.

The photometry and spectroscopy are consistent with this star being an intrinsic variable of the RV Tauri type (Rosino, 1951; Joy, 1952; Preston et al., 1963). These stars have periods of 50-150 days, are of spectral type F,G or K, and usually display alternating deep and shallow minima and/or erratic light curve variations. The complicated light curves likely arise from more than one atmospheric layer in motion, with accompanying interactions and shocks (Baird, 1982; Wallerstein and Elgar, 1992).

HR Del will remain on our observing program, so we expect light curve points on this new variable will continue to accumulate.

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1990 AND 1991 PHOTOMETRY OF UZ LIBRAE

Bopp *et al.* (1984) report photometry and spectroscopy of UZ Librae (= #102 in the catalog of Strassmeier *et al.* 1988). Grewing *et al.* (1989) use both photometric and spectroscopic data to deduce properties of the individual components of UZ Lib and to refine both the photometric and orbital periods. Heckert and Hickman (1991) have UBV photometric data from 1988 and 1989.

In this paper, I present new UBVRI photometry from May 1990 and from March and May 1991. I used the 24 inch telescope at Mount Laguna Observatory operated by San Diego State University. The photometer was equipped with a Hamamatsu GaAs phototube operating at -1450V. The data are transformed to the standard Johnson-Cousins UBVRI system. The companion and check stars are BD -07° 4044 and BD -08° 3998. Following Grewing *et al.* (1989) I computed the orbital phase using:

$$\phi=2445428.88 + 4.767885\ E.$$

The 1990 ΔV light curve (Figure 1) has roughly the same 2 spot structure as the 1988 and 1989 light curves (Heckert and Hickman 1991). However the slightly brighter maximum light at roughly phase 0.85 is consistent with the shrinking of the larger spot at phase 0.01 between 1989 and 1990. This trend continued into 1991. The 1991 light curve shows a single peak structure. The spot at phase 0.01 is gone leaving a single spot at phase 0.5. Note that the points on the 1991 curve at phases 0.01 and 0.21 are from March 1991, and the others are from May 1991. These 2 points are about 0.02 magnitudes fainter than the trend of the other points on the curve. This faintness suggests that the spot had not quite

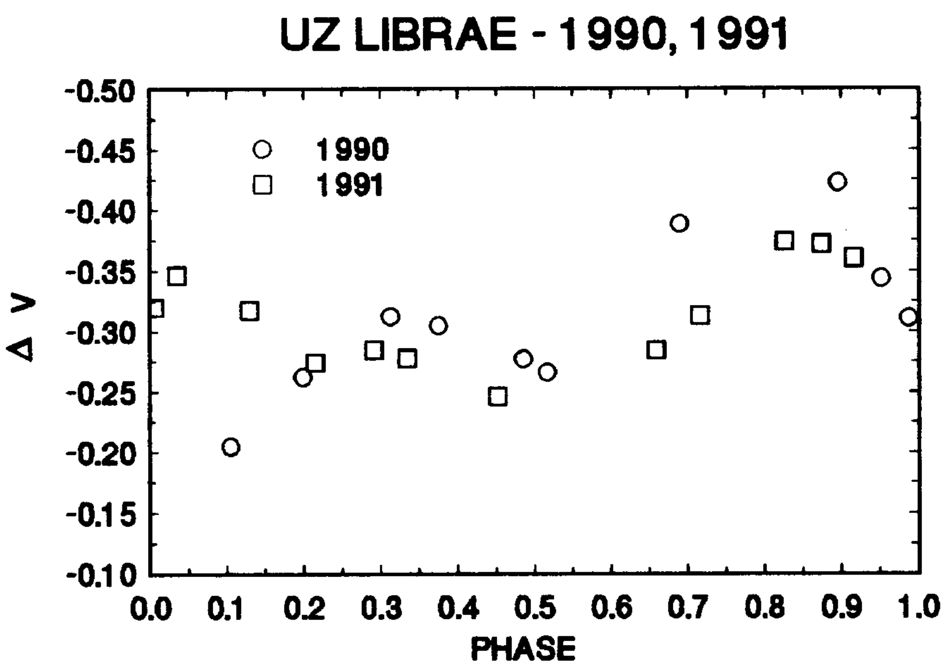

Figure 1

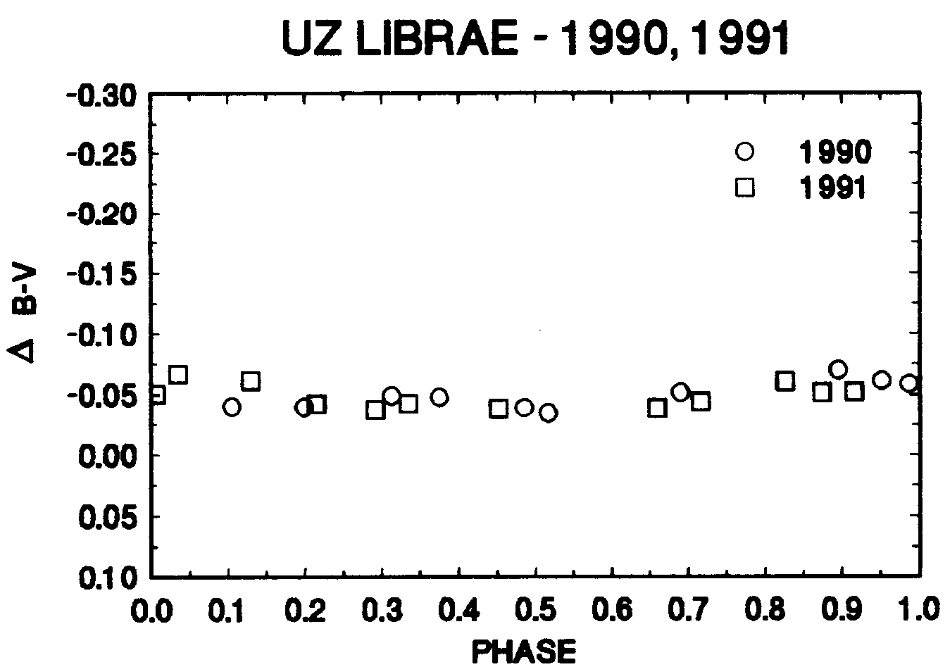

Figure 2

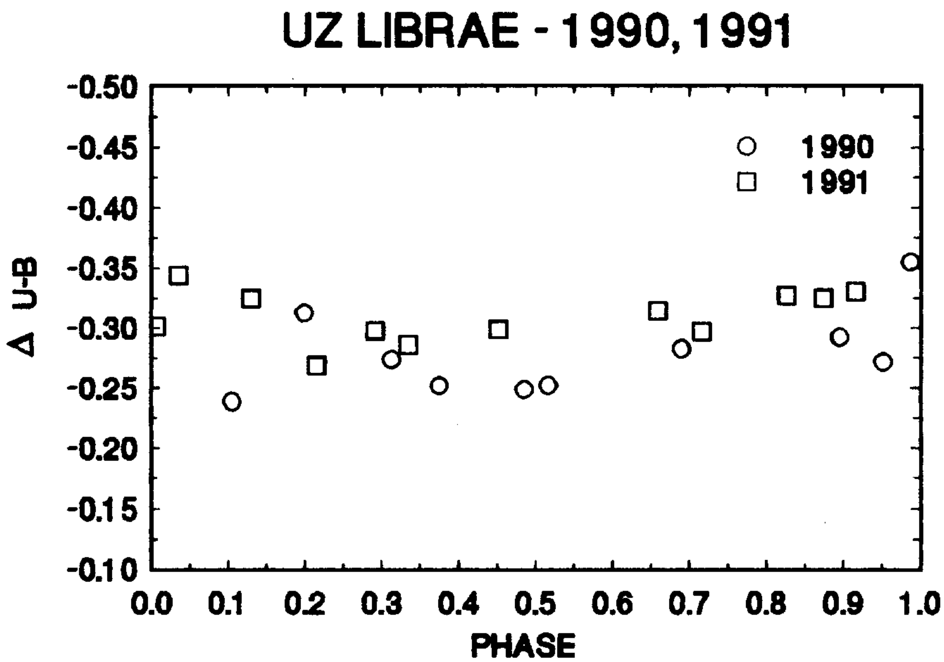

Figure 3

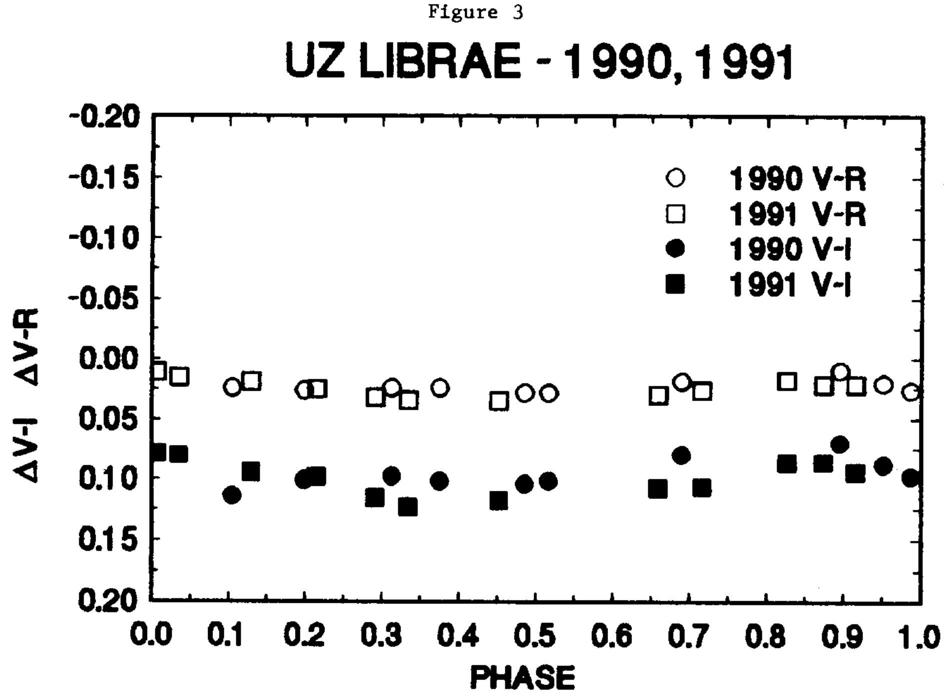

Figure 4

completely disappeared by March 1991. The amplitude of the ΔV light curves are 0.22 and 0.12 magnitudes in 1990 and 1991 compared to 0.2 and 0.3 magnitudes in 1988 and 1989 (Heckert and Hickman 1991). The relative stability of the 2 spot structure from 1988 to 1990 combined with the changes in amplitude suggests that the basic spot structure of UZ Lib remains relatively stable over time scales of a few years, but that the size of the spots can vary over faster time scales. Also note that during 1991 the star was fainter at maximum light than during 1990. This fact suggests that the spot that broke up between 1990 and 1991 did not disappear completely, but rather spread more evenly around the star.

The Δ(U-B) (Figure 3) color curve shows that the star is more red at minimum light. The Δ(B-V), Δ(V-I), and Δ(V-R) (Figures 2 and 4) color curves also show this trend but with a very small amplitude. This behavior is what one would expect if cooler spots cause the photometric variations.

Ron Angione scheduled very generous amounts of time on the Mt. Laguna 24" telescope for this work. The Research Corporation provided support for this work.

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First photoelectric BV lightcurves, improved position and ephemerides for the totally eclipsing EW type system V432 Per

[BAV Mitteilungen Nr. 61]

V432 Per = S 10154 Per was announced as a short period variable by Hoffmeister (Hoffmeister 1968a) with a range between 10.5 mag and 11 mag. He classified the star as a possibly eclipsing variable and gave two photographic plate minima (Hoffmeister 1968b). Pinto and Romano investigated the star in their photographic research. They confirmed the type of variability and found the range between 11.4 mag and 12.0 mag. They communicated six photographic plate minima, derived from them first elements as

$$\mathrm{Min\,I} = \mathrm{HJD}\quad 2438670.55 + 0.5271396 \cdot \mathrm{E}$$

and published a first photographic light curve (Pinto and Romano 1976). Busch and Häußler (1979) investigated this star on plates of the Sonneberg sky survey and reported 32 minima. From these they derived new elements as

$$\mathrm{Min\,I} = \mathrm{HJD}\quad 2435874.376 + 0.321517 \cdot \mathrm{E}$$

with a range between 11.0 mag and 11.7 mag. The type was given as EW. With these data V432 Per was included in the GCVS (Kholopov et al., 1987). Since that, eleven times of minimum light were published by the BBSAG (Diethelm 1990a, 1990b and 1991).

The unusually large scatter in the O–C–Diagram, derived from the BAV Database of D. Lichtenknecker and the contradictory elements made V432 Per a candidate for the program of the author.

The observations were made at the private observatory of the author with a 0.35 m automatic photoelectric telescope (Agerer 1988). The photometer was equipped with an uncooled EMI 9781A tube and Schott filters for B and V. Minimum timings are calculated using the Kwee–van Woerden method (Kwee, van Woerden 1956). V432 Per was observed on six nights between Dec. 1991 and Oct. 1992, mostly in two colors. SAO 038613 served as comparison star and SAO 038621 to check its constancy. Six primary and two secondary minima were observed (Table 1). The primary minima showed a constant phase of d = 25 min in V and somewhat less in B. The light in secondary minima was constant for 40 min in V and for 35 min in B. The amplitudes for the primary minimum were 0.62 mag in V and 0.74 mag in B. For the secondary minima the amplitudes were 0.36 mag (V) and 0.38 mag (B).

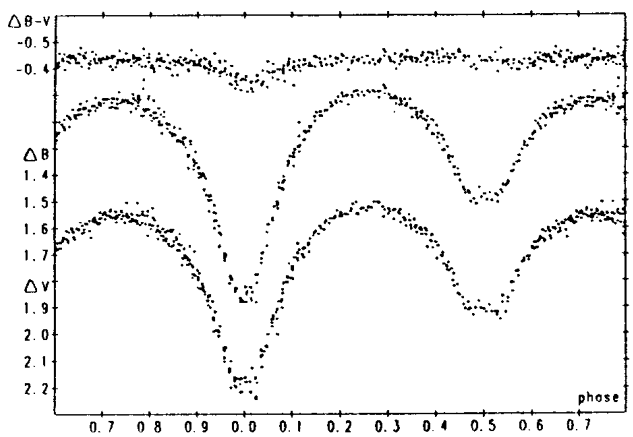

Figure 1: Differential B and V light and B–V color curves for V432 Per.

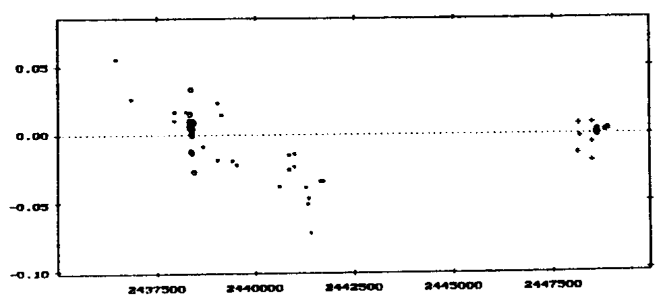

Figure 2: (O–C) Diagram for V432 Per computed with respect to the ephemeris (1). • represents photoelectric, ∘ photographic, + visual observations and ■ photographic plate minima.

Table 1: Observed times of minima for V432 Per, epochs and residuals computed with respect to the ephemeris derived in this paper.

No.	JD hel. 2400000+	Weight	Type*	Filter	Epoch	(O–C)1	(O–C)2	Observer	Source
1	35874.370	0	P::		-33203.	-0.001	0.115	[2]	VSS 9.143
2	36460.505	1	P		-31674.	0.055	0.166	[2]	"
3	36852.601	1	P		-30651.	0.026	0.133	[2]	"
4	37946.555	1	P		-27797.	0.017	0.114	[2]	"
5	37959.581	1	P		-27763.	0.010	0.107	[2]	"
6	38240.553	1	P		-27030.	0.017	0.111	[2]	"
7	38289.609	1	P		-26902.	0.009	0.103	[2]	"
8	38317.592	1	P		-26829.	0.011	0.104	[2]	"
9	38322.569	10	F		-26816.	0.005	0.098	[2]	"
10	38325.637	10	F		-26808.	0.006	0.100	[2]	"
11	38331.587	10	F		-26792.5	0.015	0.108	[2]	"
12	38356.491	10	F		-26727.5	0.004	0.097	[2]	"
13	38370.465	10	F		-26691.	-0.013	0.080	[2]	"
14	38371.278	10	F		-26689.	0.034	0.127	[2]	"

Table 1 (cont.)

No.	JD hel. 2400000+	Weight	Type*	Filter	Epoch	(O–C)1	(O–C)2	Observer	Source
15	38373.353	10	F		-26683.5	0.000	0.093	[2]	VSS 9.143
16	38373.531	10	F		-26683.	-0.013	0.080	[2]	"
17	38385.426	10	F		-26652.	-0.001	0.092	[2]	"
18	38399.236	10	F		-26616.	0.010	0.103	[2]	"
19	38399.418	10	F		-26615.5	0.000	0.093	[2]	"
20	38406.495	10	F		-26597.	-0.014	0.079	[2]	"
21	38410.346	10	F		-26587.	0.004	0.097	[2]	"
22	38439.290	10	F		-26511.5	0.008	0.101	[2]	"
23	38440.404	10	F		-26508.5	-0.028	0.065	[2]	"
24	38670.60	1	P		-25908.	-0.01	0.082	[1]	AN 290.277
25	39038.566	1	P		-24948.	-0.019	0.068	[2]	VSS 9.143
26	39058.540	1	P		-24896.	0.023	0.110	[2]	"
27	39151.292	1	P		-24654.	0.014	0.100	[2]	"
28	39436.44	1	P		-23910.	-0.02	0.064	[1]	AN 290.277
29	39527.281	1	P		-23673.	-0.023	0.060	[2]	VSS 9.143
30	40624.295	1	P		-20811.	-0.039	0.034	[2]	"
31	40863.492	1	P		-20187.	-0.027	0.044	[3]	MSAI 47.236
32	40863.503	1	P		-20187.	-0.016	0.055	[3]	"
33	41008.385	1	P		-19809.	-0.024	0.045	[3]	"
34	41008.395	1	P		-19809.	-0.014	0.055	[3]	"
35	41272.470	1	P		-19120.	-0.039	0.027	[3]	"
36	41335.320	1	P		-18956.	-0.052	0.014	[2]	VSS 9.143
37	41363.306	1	P		-18883.	-0.047	0.018	[2]	"
38	41417.327	1	P		-18742.	-0.073	-0.008	[2]	"
39	41657.316	1	P		-18116.	-0.035	0.028	[3]	MSAI 47.234
40	41717.304	1	P		-17959.5	-0.035	0.028	[2]	VSS 9.143
41	47924.393	0	V::		-1766.	-0.058	-0.052	[4]	BBS 94
42	47929.376	0	V::		-1753.	-0.058	-0.052	[4]	"
43	47946.407	0	V::		-1708.5	-0.084	-0.078	[4]	"
44	47956.355	0	V::		-1683.	-0.089	0.095	[4]	"
45	48128.548	5	V		-1233.5	-0.015	-0.011	[5]	BBS 96
46	48163.451	5	V		-1142.5	0.007	0.011	[5]	"
47	48176.474	5	V		-1108.5	-0.002	0.001	[5]	"
48	48189.435	0	V::		-1074.5	-0.074	-0.070	[4]	"
49	48481.598	5	V		-312.5	0.008	0.009	[5]	BBS 98
50	48484.636	5	V		-304.5	-0.021	-0.020	[5]	"
51	48487.525	5	V		-297.	-0.007	-0.006	[5]	"
52	48601.3739	20	E	B	0.	-0.0004	-0.0006		this paper
53	48601.3741	20	E	V	0.	-0.0002	-0.0004		"
54	48602.3331	20	E	B	2.5	0.0005	0.0003		"
55	48602.3338	20	E	V	2.5	0.0012	0.0010		"
56	48602.5246	20	E	V	3.	0.0004	0.0002		"
57	48602.5247	20	E	B	3.	0.0005	0.0003		"
58	48624.3711	20	E	B	60.	-0.0017	-0.0021		"
59	48624.3713	20	E	V	60.	-0.0015	-0.0019		"
60	48624.5662	20	E	V	60.5	0.0017	0.0013		"
61	48624.5675	20	E	B	60.5	0.0030	0.0026		"
62	48645.4552	20	E	V	115.	0.0004	-0.0002		"
63	48832.5116	20	E	B	603.	0.0021	-0.0002		"
64	48832.5118	20	E	V	603.	0.0023	0.0000		"
65	48893.4584	20	E	B	762.	0.0028	-0.0001		"
66	48893.4590	20	E	V	762.	0.0034	0.0005		"

[1]: C.Hoffmeister, [2]: H.Busch & K.Häußler, [3]: G.Pinto & G.Romano, [4]: H.Peter, [5]: J.Vandenbroere.
*) P denotes pg plate min., E photoel. min., F photographic series and V visual estimates. Those marked "::" were discarded.

In compiling the light curve (Figure 1) it became evident, that the period given by Pinto and Romano, as well as the period given in the GCVS are spurious ones with the relations

$$\frac{1}{P} - \frac{1}{P_{P\&R}} = \frac{5}{7} \quad \text{and} \quad \frac{1}{P_{GCVS}} - \frac{1}{P} = \frac{1}{2}$$

respectively.

Using all available times of minima, a (weighted) least squares fit provided the following improved linear ephemeries:

$$\mathrm{Min\,I} = \mathrm{HJD}\ \underset{\pm 6}{2448601.3743} + \underset{\pm 4}{0.38330885} \cdot \mathrm{E} \qquad (1)$$

Instantaneous elements, computed from photoelectric minima only, are:

$$\mathrm{Min\,I} = \mathrm{HJD}\ \underset{\pm 1}{2448601.3745} + \underset{\pm 22}{0.38331234} \cdot \mathrm{E} \qquad (2)$$

Together with all previous minima, found in the BAV Database, this ephemeris indicates, there has been a distinct increase of the period since 1968 (Figure 2).

In the course of this investigation the declination given by Hoffmeister and in the GCVS was found to be somewhat erronous. From a copy of a Palomar Sky Survey print the position was redetermined through differential measurements against five SAO stars, distributed in a field of 1° × 1° around V432 Per as:

$$\alpha_{2000} = 3^h\ 10^m\ \underset{\pm 0.1^s}{10.8^s} \qquad \delta_{2000} = +42^\circ\ 52'\ \underset{\pm 1''}{12''}$$

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On the Variability of BD-3°5183

The star GSC 5198.00659 was reported to be variable by Hutton 1992. The star's position, brightness (V=9.8), color (B-V)=0.7, and finder chart are also given in Hutton 1992. This is a report of my observations of this star, also known as BD-3°5183.

BD-3°5183 was observed using the 0.5 meter reflector of the Climenhaga Observatory at the University of Victoria on ten nights between 31 July 1992 and 31 August 1992, using a photometer based on the Thomson 7882 CDA CCD chip. Computer control of the telescope allowed pointing it at the stars at the beginning of the night and then leaving it to follow the stars until either dawn, thick clouds or too large an airmass occured and observations were terminated. At the end of the night the computer closed the dome and stopped the telescope drive. Many of the nights were not of photometric quality, however the sky, variable, and comparison stars were observed on the same CCD frame, so thin clouds did not degrade the differential measurements. Due to the proximity of the variable and comparison stars in position, no extinction correction was neccessary and none has been made. The filters used with our CCD camera closely match the standard system (Robb et al 1992), so mean transformation coefficients have been used to transform the data to the standard system (Landolt 1983).

The small size of the CCD chip restricts our field of view to 8X5 arc minutes and so our choice of comparison and check stars was limited. For the comparison star we used SAO145329 at RA=$21^h21^m46^s$, Declination=$-3°11'57"$ and magnitude= 9.1 (Equinox 2000), where the position and magnitude are from the Hubble Space Telescope Guide Star Catalog (Jenker et al. 1990) and the spectral type is quoted as K0 in the SAO catalog. The exposure time was kept constant at 60 seconds for R band and 111 seconds for V band. Since there was no star in the field of view of the CCD bright enough to give an adequate signal, no check star was observed.

At the telescope the first frames showed the variable star's image to be elongated in the north-west direction, while the comparison star's image was round. To increase the resolution by decreasing the apparent seeing disc, (FWHM) a few one second exposures were made with no filter. These short exposures show a faint companion to the north-west. Using the ALLSTAR routines of DAOPHOT (Stetson 1987), simultaneous fits of the point spread function (FWHM=3") to the merged images of components A and B were made. Six frames were measured and the separation was found to be 5.2" $\pm$ 0.2" with a position angle of 321 ± 2 degrees east of north. The magnitude difference was 3.9 ± 0.2, but since no filter was used this magnitude can not be put on the standard system. Very roughly it corresponds to the red region of the spectrum. Many W UMa stars are part of multiple star systems, so the likelihood of this being a true multiple system is high, but the period of such a component would be so long that no change is likely to be measurable for a hundred years (Chambliss 1992).

Table 1

2448835.7737 ± .0012
2448844.7616 ± .0003
2448844.9481 ± .0003
2448845.8848 ± .0006
2448852.8126 ± .0004
2448853.9351 ± .0004
2448858.8033 ± .0003
2448859.7404 ± .0004
2448859.9275 ± .0005
2448866.8560 ± .0004

Inspection of plots of the brightness of each of the stars for each night shows sinusoidal periodic variation of BD-3°5183. The longest nights show two minima and that the amplitude is about 0.3 magnitudes. Times of minimum were found for each well observed minimum and are given in Table 1. These times of minima are found from the method of Kwee and van Worden (1956) from all the data points within 0.03 days of each minimum. A least squares fit to these minima gives the ephemeris:

$$HJD\,Min\,I = 2448835.7736(3) + 0^{d}.374479(7)\,E.$$

Where the numbers in brackets are the errors in the last decimal place. The root mean square error of the times of minima from this ephemeris is 0.0005 days. This period is in good agreement with the period-color relation of Eggen (1967) for contact binaries. Inclusion of the eleven points from Hutton (1992), are almost consistent with this period and epoch, except for the the one at JD 2448507.6504, which falls below the curve by 0.2 magnitudes. These points have not been included in the determination of the period, since it is not known that the times of observations have been corrected to heliocentric time.

The V band light curve is plotted in Figure 1 according to the period discussed above and clearly shows the variation expected of a W UMa system. The flat minimum and small amplitude indicate an extreme mass ratio and large inclination of the orbital plane. The light curve modeling program LIGHT written by G. Hill and S. Rucinski (1992) was used to model the system. One hundred normal points were formed from the best nights for each of the R and V light curves. Figure 2 shows the R band normal points and the line is from the model; with inclination=78.3 degrees, mass ratio=0.146 and filled fraction=0.475. Where a filled fraction of 0.0 is the inner contact surface and 1.0 is the outer surface. Figure 3 shows the V band normal points and the line is from the model; with inclination=78.2 degrees, mass ratio=.164 and filled fraction=0.49. For these runs only the inclination, mass ratio, and filled fraction were allowed to vary. The temperature of both components was held constant at 6500 degrees, consistent with the average (B-V) reported by Hutton (1992). This temperature implies a convective envelope so the gravity darkening exponent β was chosen to be 0.08 and the reflection efficiency was 0.5. For some runs of the model the temperature of the secondary was allowed to vary, but it changed by only about 10 degrees, so it was kept constant for the final runs. Simultaneous fits were also made to both colors, but no difference was seen. The light from the third component was not made a variable parameter, since it was measured to be so small, and would be a constant offset of the light curve. The asymmetry of the maxima preclude a good fit in that part of the curve and are probably due to star spots. The uncertainty of the fitted parameters are difficult to acertain, but from twenty runs of the model I estimate the uncertainty to be about 1.5 degrees in inclination, 0.1 in the filled fraction, and 0.02 in the mass ratio.

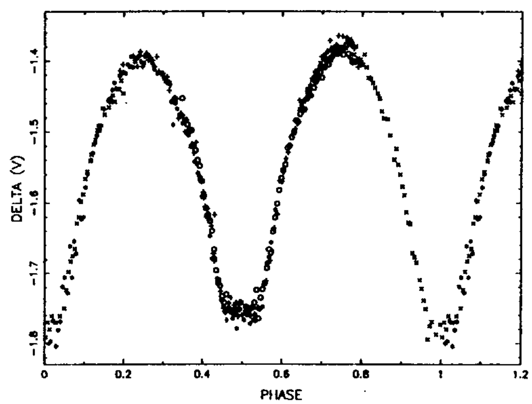

Figure 1. Light curve of BD-3°5183 in the V band plotted with the PHASE = (HJD - 2448835.7736) / 0.374479

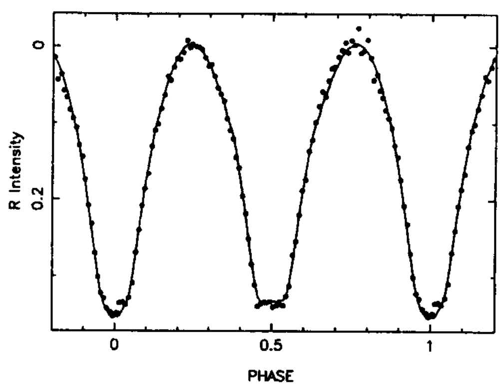

Figure 2. Normal points of BD-3°5183 in the R band plotted with the model light curve with inclination=78.3°, mass ratio=0.146, and filled fraction=0.475.

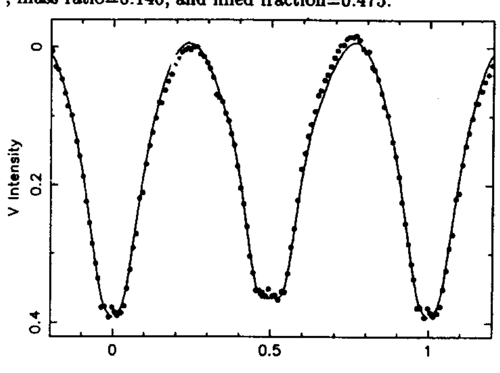

Figure 3. Normal points of BD-3°5183 in the V band plotted with the model light curve with inclination=78.2°, mass ratio=0.164, and filled fraction=0.49.

Contact systems are generally divided into A-type and W-type systems. The BD-3°5183 system has a light curve shape, small mass ratio and large filled fraction all consistent with it being an A-type system. The (B-V)'s reported by Hutton (1992), despite having an unusually large range of 0.63 to 0.78, after correcting for reddening, estimated from Burstein and Heiles (1982) to be approximately E(B-V)=0.08, indicate a spectral type later than G0. Since all A-type systems are hotter than G0 (Rucinski 1985) with the possible exception of FG Hya, the only other contact binary with an A-type light curve and a W-type color. The explanation for FG Hya's light curve is, that an unusual spot distribution is thought to distort the light curve and make it appear to be an A-type system.

Further observations of this very interesting system are urged. Spectroscopic observations are needed to allow spectral classification of the contact system and establish whether BD-3°5183 is an A-type or a W-type. High resolution spectra would allow spectroscopic determination of the mass ratio and hopefully support the rather small photometric mass-ratio. Further photometric observations will be of interest to refine the determination of the period and to check for period changes indicative of the system merging to become an FK Comae type system. Light curve changes are also expected, if the system is similar to FG Hya, and has many large and variable star spots.

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ON THE PERIOD OF 44 i BOOTIS

The period of the W UMa system 44 i Bootis has been studied extensively. Recently Oprescu et al. (1989, 1991) reported that sudden period changes occurred in 1977-1978 and in 1986-1987. Burke, et al. (1992) re-analyzed the data set of Oprescu, et al. (1991) as well as some new observations, and reported a new quadratic ephemeris representing a continuously changing period.

I observed 44 i Bootis on six nights from May 1990 through May 1992, obtaining 14 new photoelectric records of 8 eclipse minima (5 primary, 3 secondary) as shown in Table 1. The observations were made from Running Springs, CA, USA (elevation = 1870m) using a 35cm Schmidt-Cassegrain telescope and an Optec SSP-3 photometer. Johnson B and V filters were used for all nights except JD 2448058 which was in V only. A PC-based data acquisition system (Jones, 1991) recorded all integrations along with the mean time of each integration accurate to ± 1 second. Data reduction was by conventional methods to extinction-corrected differential instrumental magnitudes vs. the comparison star 47 k Bootis. No check star was used. Epochs of minimum were determined graphically by the method of bisection of chords. The error estimates in Table 1 are the standard deviations of the midpoints of the chords. The data are available from the IAU Archives as file number 250E.

Table 1. Observations

UT	HJD (+2400000)	FLTR	TYPE
06 May 90	48017.8247 ± 0.0008	B	II
	48017.8252 ± 0.0007	V	II
	48017.9584 ± 0.0003	B	I
	48017.9588 ± 0.0004	V	I
16 June 90	48058.8007 ± 0.0005	V	II
	48058.9354 ± 0.0012	V	I
02 July 90	48074.7360 ± 0.0002	V	I
	48074.7362 ± 0.0009	B	I
15 May 91	48391.8320 ± 0.0002	V	I
	48391.8327 ± 0.0009	B	I
19 April 92	48731.8291 ± 0.0011	V	II
	48731.8297 ± 0.0004	B	II
02 May 92	48744.8179 ± 0.0003	V	I
	48744.8182 ± 0.0003	B	I

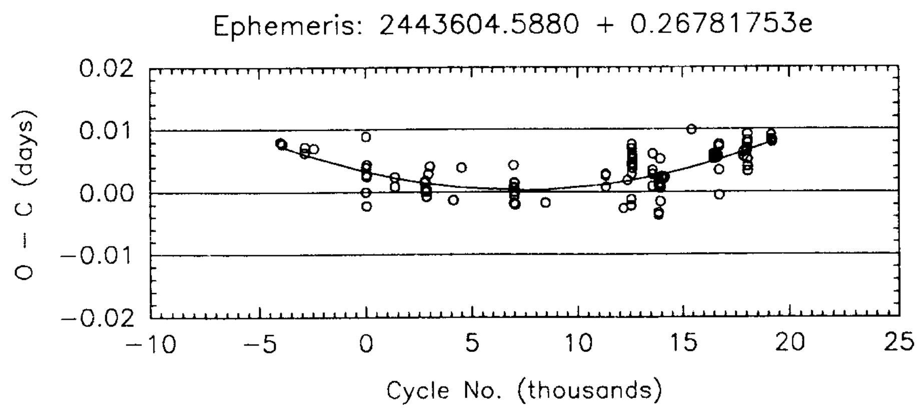

Fig. 1. O-C plot for 44 Bootis, resulting from the "pre-1987" linear ephemeris of Oprescu et al. (1989). The solid line represents a parabolic fit described by eq. 1 which was used to derive the new quadratic ephemeris of eq. 3.

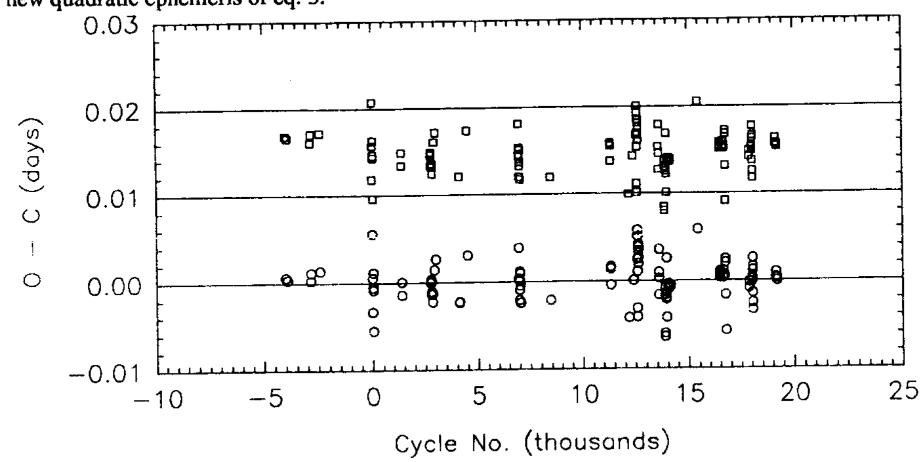

Fig. 2. O-C plot for 44 Bootis. Circles represent points calculated using eq. 3, squares represent points calculated using the quadratic ephemeris of Burke, et al. (1992).

When I attempted to check the new times of minimum in Table 1 against the ephemeris of Burke, et al. it appeared that the initial epoch of that ephemeris was in error. I therefore repeated the analysis by Burke, et al. but with slightly different initial assumptions. They disregarded minima in the data set of Oprescu, et al. (1991) prior to JD 2443604 whereas those points were included in this analysis. I have also included the new observations listed in Table 1. The most important difference is that Burke, et al. assumed that the initial epoch used by Oprescu, et al. was "grossly in error". I believe instead that the discrepancy resulted from the incorrect assumption by Oprescu, et al. that the same initial epoch can be valid both before and after a sudden period change. If one accepts that the "post-1987" line in fig. 2 of Oprescu, et al. (1991) represents an instantaneous period (that is, a line tangent to the curve which accurately describes the period change), then both the initial epoch and the period can be valid. Otherwise, as noted by Burke, et al., one must reject the ephemeris on the grounds that the graph is inconsistent with the reported initial epoch.

Figure 1 was plotted using the "pre-1987" ephemeris of Oprescu, et al. All of the values are plotted individually, that is, minima of the same epoch in different filters are not collapsed to means. The solid line in Fig. 1 represents the result of a parabolic least-squares fit which yields the function:

$$f(e) = \underset{\pm 6.58\times10^{-12}}{5.45\times10^{-11}}\,(e^2) - \underset{\pm 1.2\times10^{-7}}{8.0\times10^{-7}}\,(e) + \underset{\pm 4.87\times10^{-4}}{3.272\times10^{-3}}. \qquad (1)$$

Adding the assumed linear ephemeris

$$\text{Pr. min.} = 2443604.5880 + 0^d.26781753\,(e) \qquad (2)$$

to equation 1 yields the corrected nonlinear ephemeris:

$$\text{Pr. min.} = \underset{\pm.0005}{2443604.5913} + \underset{\pm.00000012}{0^d.26781673}\,(e) + \underset{\pm 6.58\times10^{-12}}{5^d.45\times10^{-11}}\,(e^2). \qquad (3)$$

The errors are standard errors from the least-squares fit.

Fig. 2 is the data set of Fig. 1, where open circles represent points calculated using eq. 3, and open squares are points calculated using the quadratic ephemeris of Burke, et al. The latter are clearly shifted systematically by an error in initial epoch, although the coefficients of the e and e^2 terms in their quadratic ephemeris are consistent with mine, within the respective standard errors. Eq. 3 provides a good fit to the data, with only a small shift in the initial epoch of Oprescu et al. imposed by the least-squares process, leading to the conclusion that the initial epoch of Oprescu et al. was in fact, essentially correct (O-C = -0.0033).

As noted by Burke, et al., evaluating the derivative of the quadratic ephemeris at some epoch yields a value for the instantaneous period at that epoch. To use Burke, et al.'s example, at E = 18054, eq. 3 yields a value of $P = 0^d.26781870$, close to the value reported by Oprescu, et al. For the "pre-1987" period, solving the derivative of eq. 3 at the initial epoch predicts a slightly shorter period than that reported by Oprescu, et al. (1989).

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Spectral Types for Variable Stars Lacking Quoted Spectral Types in the 4th ed. of the GCVS

Name	My Spec	R.A. (1950)	DECL.	Notes
FT Cas	M10	00 22 14.8	59 14 51	*
AV Cas	M8	00 56 30.4	60 27 11	*
V488 Cas	M7	02 34 05.2	62 48 49	
V363 Per	M9	02 37 32.6	55 00 12	
QR Per	M7	02 57 04.6	56 02 20	
VV Per	M6	03 23 23.7	49 32 35	
FG Ser	M9	03 49 54.4	47 30 12	S-type according to MacConnell
V387 Per	M8,9	04 15 38.4	44 29 07	
V348 Per	M8	04 41 41.6	49 42 23	
DU Aur	M9	05 08 01.2	31 16 12	
AT Aur	M9	05 19 51.6	36 08 18	
IX Tau	M9	05 35 28.1	25 24 16	
LZ Aur	M7	05 35 52.2	29 53 57	Case 1b 171, M7 (Ap.J. **120**, 478)
IZ Tau	M9	05 41 25.1	28 16 47	
FX Aur	M7	05 51 10.9	28 36 01	
MS Aur	M7	05 53 23.3	31 51 35	
TY Gem	M9	06 27 03.8	16 37 49	
DZ Mon	M7	06 47 28.2	-04 46 06	
V378 Mon	M7	06 48 04.1	-01 25 25	
XY Mon	M6	06 49 50.6	-03 24 56	
V529 Mon	M6,7	07 00 24.1	01 14 22	
MZ Mon	M7,7	07 13 47.8	-02 13 24	
CT Pup	M9	07 32 29.4	-25 14 46	
UW Pup	M9,9	07 39 34.0	-16 29 25	Me in Ap.J. **142**, 943.
UX Pup	M6	07 41 34.5	-13 46 57	*
DW Pup	M6-9	07 43 11.9	-20 37 45	
HR Pup	M6	07 50 46.9	-20 44 55	
ES Pup	M6	07 51 50.0	-19 12 22	
V544 Oph	M7	17 36 40.7	-24 41 03	
V1713 Sgr	M9	17 46 58.9	-29 12 39	
UY Sgr	M9	17 49 03.7	-22 36 11	
V1951 Sgr	M9	18 00 27.9	-23 00 01	
V3908 Sgr	M8	18 10 41.5	-16 14 44	
V1974 Sgr	M7p	18 19 00.4	-23 23 43	
V3937 Sgr	M5r	18 21 34.2	-16 11 43	
V386 Sct	M8	18 24 23.0	-15 51 27	
V409 Sct	M6	18 26 49.4	-14 01 40	
V927 Oph	M7	18 35 51.7	06 49 35	
V371 Sct	M9	18 40 48.2	-10 56 16	
CE Sct	M8-9	18 43 19.3	-05 41 28	

Name	My Spec	R.A. (1950)	DECL.	Notes
IM Sct	M6	18 48 15.7	-09 10 55	
LM Her	M9	18 47 56.2	12 08 52	Another late M is 1½' nne.
DQ Sct	M8-9	18 49 53.7	-08 02 48	
QW Sct	M9	18 53 14.0	-08 00 55	
V598 Aql	M7	18 56 14.7	-06 52 08	
V886 Aql	M7,8	18 56 35.9	-01 23 18	
CK Aql	M6	18 59 51.4	-04 59 15	
FI Aql	M9	19 01 32.7	13 57 23	
CN Aql	M9	19 04 52.6	-08 18 23	
V966 Aql	M7	19 09 23.8	-02 07 08	
V349 Aql	M7,7	19 09 35.6	-00 48 26	
V1123 Aql	M9-9	19 17 26.2	06 48 18	
V1124 Aql	M9	19 18 05.7	02 24 27	
V360 Aql	M6	19 20 28 4	02 39 46	
V366 Aql	M7	19 23 53.1	02 11 09	
V1438 Cyg	M5	19 28 49.0	28 48 49	
HL Sge	M9	19 33 30.4	16 43 50	
FT Vul	M9	19 34 22.1	27 02 54	
V641 Aql	M9	19 35 29.1	09 21 16	
V916 Cyg	M8	19 35 06.1	31 03 50	
LV Aql	M9	19 36 48.5	12 48 30	
V929 Cyg	M9p	19 36 54.1	32 17 15	
LY Aql	M9-10	19 37 25.6	12 32 45	
V653 Aql	M8-9	19 38 16.3	09 55 33	
HW Cyg	M6	19 38 22.9	32 39 04	M2 in Ap.J. 124,346 (i.d. uncertain)
FX Vul	M7	19 39 24.1	24 00 42	
GG Vul	M7	19 40 02.5	20 21 44	
GK Vul	M7	19 41 52.0	24 02 29	
IO Cyg	M6	19 42 39.0	32 21 52	M8 in Ap.J. Suppl. **4**, 73.
V1152 Cyg	M6	19 46 10.7	36 18 25	
V1000 Cyg	M7	19 47 57.6	35 41 40	
ET Cyg	M6	19 49 21.5	31 10 30	
V543 Cyg	M8-9	19 51 09.8	32 12 40	
SX Sge	M9	19 51 34.7	18 14 11	
V1458 Cyg	M6	19 53 31.6	30 54 36	
V1166 Cyg	M6	19 54 39.3	39 42 39	
V1461 Cyg	M5	19 54 54.3	40 15 23	
V1298 Cyg	M6	19 57 34.1	41 12 33	
GV Sge	M6	19 58 33.6	20 56 45	
V1360 Cyg	M9	19 58 50.5	35 06 18	
EM Sge	M8	19 59 08.2	20 46 12	Close to V484 Cyg, a different star.
GH Sge	M8p	20 00 45.7	21 24 40	
BT Sge	M7	20 04 24.3	21 26 26	
V1367 Cyg	M8	20 08 49.2	40 29 54	
V1317 Cyg	M9	20 11 54.4	40 57 15	
V1650 Cyg	M6,7	20 16 49.3	39 08 32	
V1656 Cyg	M7,9	20 23 35.0	42 22 35	
V1658 Cyg	M9	20 23 40.8	42 16 40	
V1517 Cyg	M9	20 28 53.9	32 21 20	
V1201 Cyg	M8	20 37 16.3	44 54 56	*

Name	My Spec	R.A. (1950)	DECL.
V1210 Cyg	M8-9	20 44 57.5	32 49 40
CC Cyg	M5	20 46 23.3	53 51 33
V1223 Cyg	M8	21 02 49.5	41 00 46
V1663 Cyg	M6	21 06 57.1	46 20 11
V580 Cyg	M7	21 09 00.1	44 37 45
V529 Cyg	M8-9	21 11 03.1	39 56 12
V589 Cyg	M8	21 15 12.2	47 55 08
V1243 Cyg	M7,9	21 23 52.6	45 19 34
BM Cyg	M9	21 30 00.7	47 22 21
V1728 Cyg	M7,9	21 34 07.6	51 01 17
V1733 Cyg	M9,10	21 40 05.2	51 43 27
V650 Cyg	M8	21 40 07.2	44 44 01
V411 Cyg	M7	21 45 15.3	48 15 09
LS Cyg	M9	21 51 28.2	48 34 00
PY Cep	M8,9	21 52 14.0	60 18 11
V1737 Cyg	M9	21 53 10.6	49 31 29
V1406 Cyg	M7	21 55 51.3	53 09 20
DN Cyg	M9,9	21 56 25.1	51 47 52
V1739 Cyg	M9p	21 58 54.0	52 16 59
HP Lac	M9	22 02 31.0	51 29 34
II Lac	M7,7	22 04 25.7	52 44 40
IZ Cep	M8	22 06 26.1	53 40 34
KU Cep	M9	22 14 58.7	56 22 23
LN Lac	M7	22 17 52.0	54 27 13
LP Lac	M7	22 18 27.5	54 00 05
LQ Lac	M7	22 18 52.4	52 35 45
HN Cep	M7	22 23 30.5	57 00 41
DQ Lac	M7	22 25 03.3	56 34 19
QW Lac	M9	22 27 07.8	53 02 49
NV Lac	M6,6	22 29 10.8	54 56 33
GV Lac	M9,9	22 39 27.8	56 23 27
DF Cep	M8,9	22 40 56.4	57 21 23
KX Cas	M9,9	23 00 29.4	57 39 05
V430 Cas	M8,8	23 13 24.9	55 57 27

The foregoing spectral types are based on unwidened near-infrared (6800-8800 Å) objective prism plates of dispersion 1700 Å mm^{-1} at the atmospheric A band. The plates were a survey covering most of the Milky Way north of declination -20°, except for large gaps eastward of right ascension 6 hours.

Notes to the Table

FT Cas: My position is about 2½' different from the GCVS, whose position is given to only 1'. The published blue-region identification chart cannot be compared with my infrared plate. There is on the infrared plate no other visible reddish candidate for the variable star.

AV Cas: No. 150 of my carbon star catalog (2d ed.) was identified as AV Cas by Kurtanidze, but the published position of AV Cas agrees better by 2' with that of the M star. We lack the identification chart. L. Dahlmark, in IBVS 2878, has published a new variable star, LD 94, on the position of the carbon star, with i.d. chart marked accordingly. Either the GCVS position for AV Cas is in error, or both adjacent red stars are variable.

UX Pup: Listed as a Cepheid variable in P.A.S.P. **92**, 314, but that is a misprint. The GCVS gives the variability type as SR, and I confirm my M star as the variable by i.d. chart.

V1201 Cyg: Has been published as S-type, but was already corrected to late M in my S-star catalog (table of rejected S stars, both eds.)

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